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RESECTION OF THE RADIAL HEAD AND NECK

An End-Result Study of Thirteen Cases

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In the past, sufficient attention has not been directed to the end results following resection of the radial head and neck. In too many instances it has been taken for granted that the procedure is harmless and free from undesirable sequelae. Therefore, this study has been made in an effort to determine whether or not undesirable conditions at the elbow or at the wrist may result from excision of the radial head and neck.

BRIEF SURVEY OF LITERATURE

A survey of the literature reveals a number of articles concerning fractures of the radial head and neck. In discussing the treatment of badly comminuted or displaced fractures, most authors agree that excision is the accepted form of treatment. Until recent years, no end-result studies of cases so treated have been reported.

In 1935, Sutro reported four cases illustrating regrowth of bone at the proximal end of the radius following resection. In each instance, the radial head and neck had been resected because of a badly comminuted fracture. The proximal ends of the radii were described as grossly resembling the original radial heads; they were nodular, deformed, flattened, or expanded. In one case, there was a second regrowth of bone at the radial stump with a return of disabling symptoms, necessitating a third resection, fifteen months after the second excision.

Buxton, in 1936, reported a series of 100 fractures about the outer side of the elbow. In four instances, the radial head was resected because of comminuted or displaced fracture of the head or of the neck. He advised reposition of the radial head rather than excision, if possible, when the patient is under forty years of age. He considered reposition to be very desirable in children, as resection might result in extreme cubitus

valgus. Other complicating conditions were limitation of wrist motion, radial deviation of the hand, and prominence of the distal end of the ulna.

Lewis and Thibodeau, in 1937, reported the presence of deformity at the wrist following resection of the radial head and neck for badly comminuted fractures. In studying their eight cases, they did not find the degree of bone regrowth at the proximal end of the radius that Sutro noted. They expressed the belief that the apparent regrowth was, in part, due to an upward displacement of the radial shaft, caused by removal of the head and neck. Two patients presented disabling symptoms at the wrist. Roentgenograms revealed shortening of the radius at the wrist and widening of the distal radio-ulnar joint. Clinical examination showed instability of the distal radio-ulnar joint and localized tenderness at this region.

Cubbins, Callahan, and Scuderi, in 1938, stated that they were opposed to the free removal of the radial head in the treatment of fractures about the elbow, because the radius constitutes a marked support of the ulna when the distal radio-ulnar joint has remained intact. Hein reported fifty-two cases of fracture of the radial head or neck. He found that, in a large series of forearm fractures, 9.6 per cent. involved the radial head or neck. Following resection of the radial head, no mention of disability at the wrist was made. Schwartz and Young stated that the head and neck of the radius are essential for stability at the elbow and for the maintenance of the normal carrying angle of 170 degrees. Cotton thought that in children some disturbance of growth would occur after removal of the radial head, because of inclusion of an epiphyseal line in the removed bone. He felt that in adults there is some formation of a new radial head after resection. However, he considered that no loss of function should follow. Magnuson advised against radial-head removal in growing individuals, since interference with normal growth and increasing deformity were to be expected. Proper removal in adults, he believed, was followed by normal function. Speed reported the use of a transplanted fascial graft, securely sutured over the end of the radial neck, in order to secure a limiting membrane, and thus to prevent excess bone formation. Key and Conwell felt that after resection not enough new-bone formation occurs to cause disability. They rounded off the radial stump with rongeurs, and covered it over by means of a chromic-catgut purse-string suture taken in the surrounding soft tissues.

REPORT OF THIRTEEN ADDITIONAL CASES

It is desired to add to the literature a follow-up study of thirteen cases of resection of the radial head and neck. These resections were done at the New York Orthopaedic Dispensary and Hospital during the period 1920 to 1938. Table I lists the various conditions for which the resections were done and the ages of the patients at the time of operation.

In order to determine whether or not undesirable conditions at the elbow or at the wrist result from excision of the radial head and neck, a

follow-up study of these cases was undertaken with the following points in mind:

1. Pain, weakness, or tenderness at the elbow;
2. Range of pronation, supination, flexion, and extension permitted at the elbow;
3. Stability at the elbow;
4. Increase of normal carrying angle at the elbow;
5. Formation of "new radial head", or bone formation at the operative site;
6. Anterior luxation of the radial stump;
7. Pain, weakness, or tenderness at the wrist;
8. Radial deviation of the hand;
9. Prominence of the ulna at the dorsum of the wrist;
10. Motions at the wrist;
11. Proximal displacement of the radial shaft;
12. Widening of the distal radio-ulnar joint.

Roentgenograms of the elbows and of the wrists were taken when the patients presented themselves for follow-up examination. The thirteen patients were examined from two months to eighteen years after operation. The postoperative period was less than six months in two cases and less than a year in two cases. The average postoperative period for the group was four years. Nine patients were still in their growth period when operated upon, while four were over eighteen years of age (the proximal radial epiphysis ossifies at the age of from five to seven years, and unites to the shaft at from seventeen to twenty years). In four cases a second excision of the proximal end of the involved radius was required.

FINDINGS AT FOLLOW-UP EXAMINATION

Pain, Weakness, or Tenderness at Elbow

Three patients complained of slight to moderate pain and weakness when carrying heavy objects with the arm at the side; one had slight local tenderness (six years after resection). One of these patients had been operated upon because of a fractured radial head; another, because of a dislocated radial head, due to obstetrical paralysis; and the third, because of a dislocated radial head, due to multiple osteochondromata. Another patient noted clicking and momentary twinges of pain upon pronation and supination; roentgenograms revealed a small bony spur on the lateral aspect of the radial stump. This radial head had been excised because of a congenital dislocation. Nine patients had no complaints referable to the elbow.

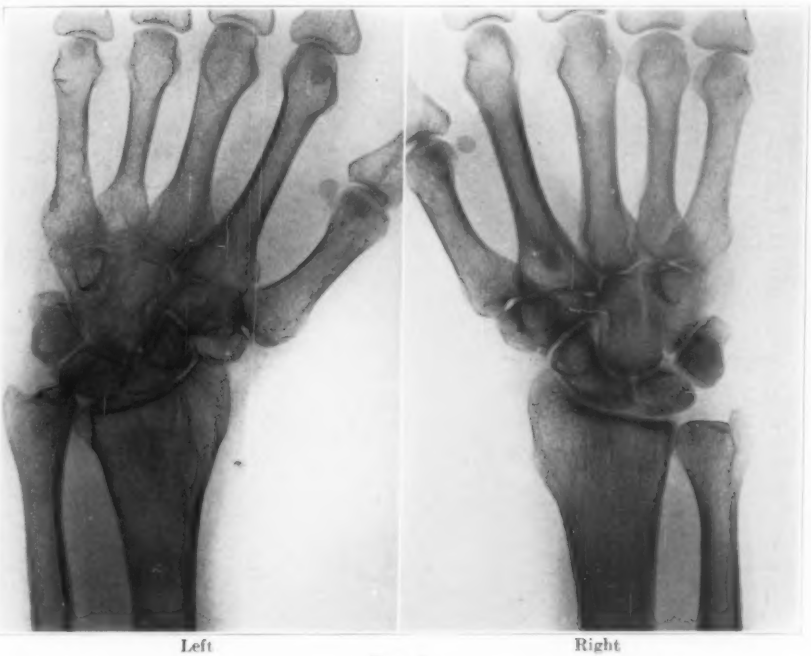
Range of Motion Permitted at Elbow

At follow-up examination, six patients presented slight to marked limitation of supination (limitations of 5, 10, 20, 65, 75, and 80 degrees). Five had full supination to 90 degrees. Eight presented slight to marked

TABLE I

CONDITIONS FOR WHICH RESECTIONS WERE DONE AND AGES OF PATIENTS AT OPERATION

Case	History No.	Sex	Pathological Condition	Age At First Resection of Head and Neck of Radius	Age At Second Excision of Proximal End of Radius
1. L. U.	151864	Male	Subluxation and malunion of radial head following fracture-dislocation 4 months previously	14 years	
2. N. B.	136915	Female	Subluxation of radial head following fracture-dislocation 28 months previously	14 years	19 years
3. J. K.	29996	Male	Fibrous ankylosis of elbow following fracture-dislocation 21 months previously	13 years	
4. E. D.	176413	Female	Fracture 8 months previously, with painful limitation of motion	60 years	
5. E. R.	184570	Male	Dislocation of radial head, due to obstetrical paralysis	12 years	
6. F. V.	126971	Male	Dislocation of radial head, due to obstetrical paralysis	8 years	
7. L. S.	149917	Female	Dislocation of radial head, due to multiple osteochondromata	9 years	13 years
8. L. C.	192499	Female	Tuberculosis of elbow, with involvement of radial head	53 years	
9. M. H.	208645	Female	Tuberculosis of elbow, with involvement of radial head	21 years	
10. M. W.	173334	Female	Tuberculosis of elbow, with involvement of radial head	14 years	
11. J. D.	129233	Male	Tuberculosis of elbow, with involvement of radial head	50 years	54 years
12. W. M.	177435	Male	Bony ankylosis of radiohumeral and ulnohumeral joints, due to suppurative arthritis	15 years	16 years
13. V. S.	184165	Female	Congenital luxation of radial head, with congenital absence of lower end of ulna	13 years	



Left Right

FIG. 1

Case 8. L. C. Left radial head and neck excised June 1, 1936 (elbow arthrodesed for tuberculosis). Roentgenograms, taken on December 3, 1938, showing proximal displacement of radial shaft, widening of distal radio-ulnar joint, and radial deviation of hand. Symptoms of disability at left wrist.

limitation of pronation (limitations of 10, 10, 15, 15, 65, 70, 85, and 85 degrees). Three had full pronation to 90 degrees. Two patients exhibited a complete loss of pronation and of supination, due to radio-ulnar ankylosis.

Before operation, four patients had a complete loss of supination. Eight had slight to marked limitation of supination (limitations of 10, 10, 30, 45, 70, 75, 80, and 80 degrees). One had full supination. Four had a complete loss of pronation. Eight had slight to marked limitation of pronation (limitations of 10, 15, 60, 60, 75, 80, 80, and 80 degrees). One had full pronation.

At follow-up examination, three patients presented limitation of flexion (limitations of 10, 15, and 50 degrees). Four had full flexion. Six presented limitation of extension (limitations of 5, 5, 5, 20, 30, and 40 degrees). One had full extension. In four of the cases, the elbow had been arthrodesed because of tuberculosis. In one case, the elbow was ankylosed following a suppurative arthritis, and in another, the elbow presented a fibrous ankylosis following an attempted arthroplasty.

Before operation, nine patients presented limitation of flexion (limitations of 20, 50, 70, 75, 80, 80, 95, 120, and 120 degrees). Two had full flexion. Eleven patients presented limitation of extension (limita-

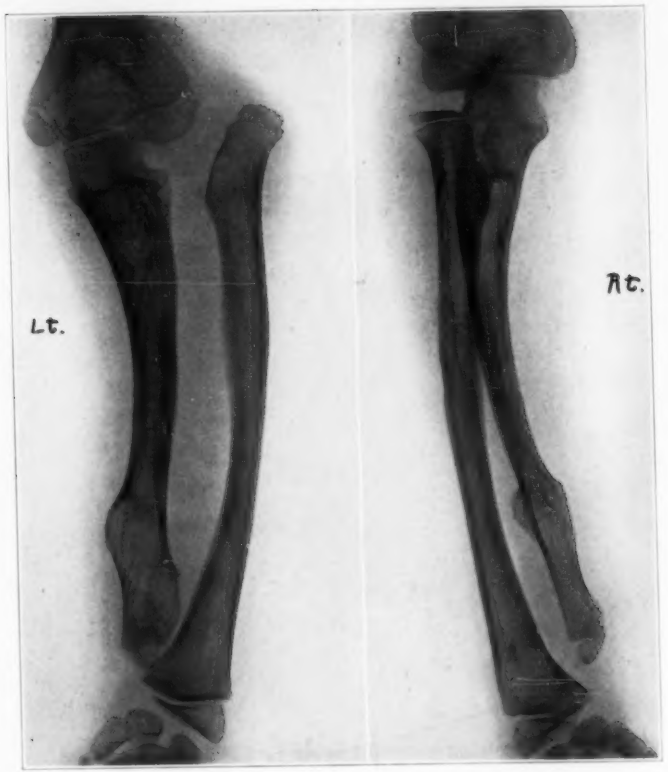


FIG. 2

Case 7. L. S. Multiple osteochondromata. Preoperative anteroposterior view of both forearms on August 1, 1934. Left radial head dislocated posterolaterally.

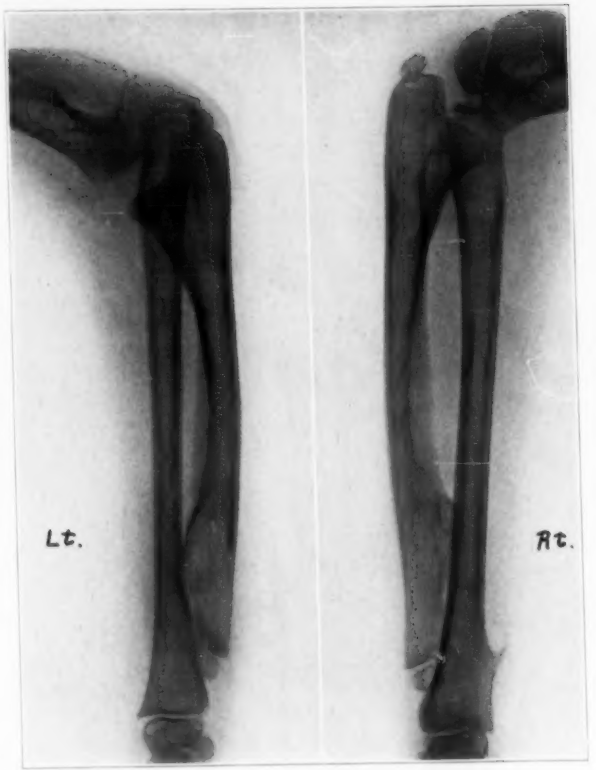


FIG. 3

Case 7. Preoperative lateral view of both forearms on August 1, 1934.

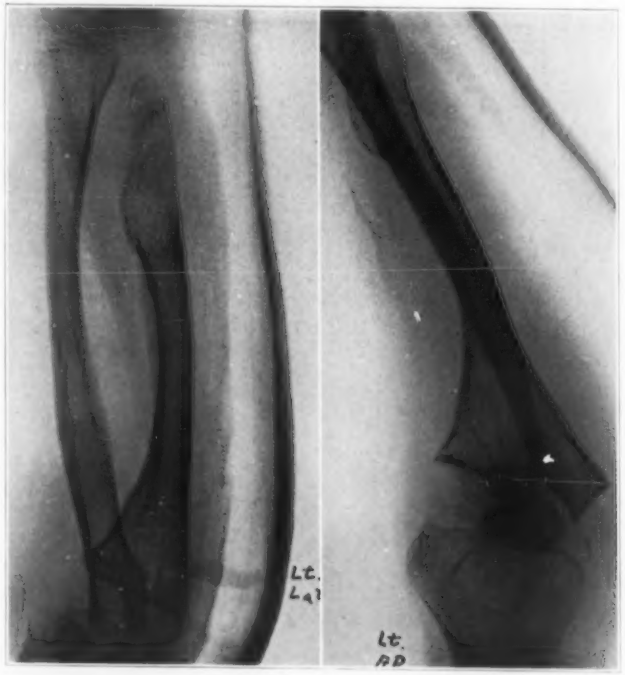


FIG. 4

Case 7. Dislocated left radial head and portion of neck excised on September 7, 1934. Postoperative anteroposterior and lateral roentgenograms taken on September 10, 1934.

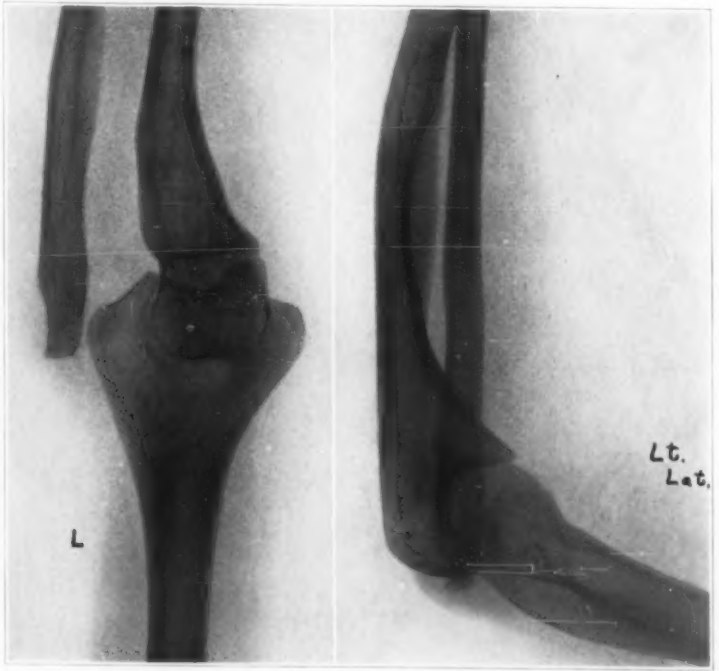


FIG. 5

Case 7. Three and one-half years after original resection of radial head and neck. Anteroposterior and lateral views taken on March 26, 1938, showing radial stump remaining dislocated, due to proximal displacement of radial shaft. No appreciable new-bone formation.

tions of 5, 15, 20, 20, 25, 30, 30, 40, 50, 60, and 60 degrees). Two patients had no flexion or extension.

It is apparent that the ranges of motion in supination, pronation, flexion, and extension have been increased by operation (excluding, of course, anteroposterior motion in the elbows arthrodesed for tuberculosis).

Stability at Elbow

No patients exhibited instability at the elbow.

Increase of Normal Carrying Angle at Elbow

Four patients presented an increased carrying angle, as compared with the normal elbow in each case. Cubitus valgus deformities of 15, 20, 20, and 30 degrees were noted. However, these patients also had flexion deformities of 5, 20, and 40 degrees, while one elbow was arthrodesed for tuberculosis at 135 degrees. The apparent cubitus valgus was

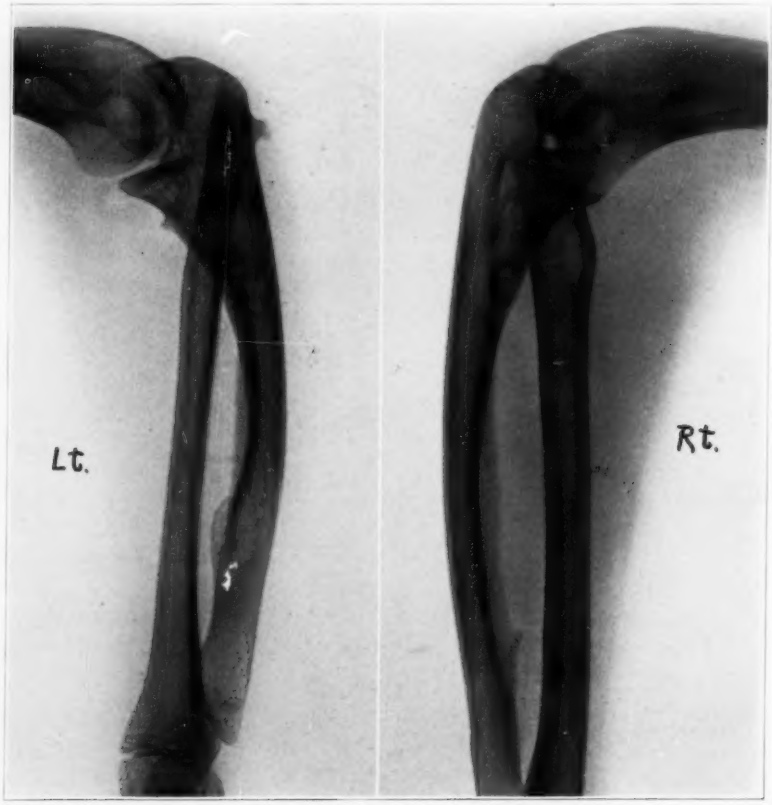


FIG. 6

Case 7. Lateral views, taken on December 3, 1938. Five months previously, on July 1, 1938, the proximal end of the radius had been resected a second time. Note spur formation at posterior aspect of left radial stump.

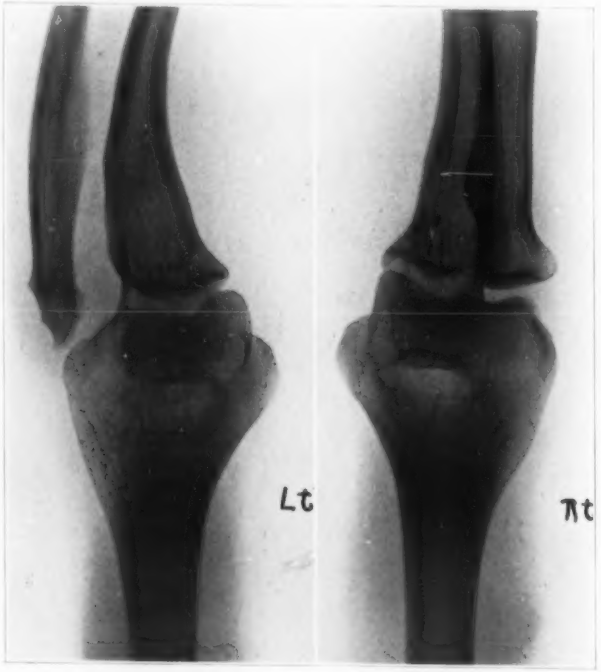


FIG. 7

Case 7. Anteroposterior views, taken on December 3, 1938 (five months after second resection of radial head). Note proximal displacement of radial shaft and moderate degree of bone formation at operative site.

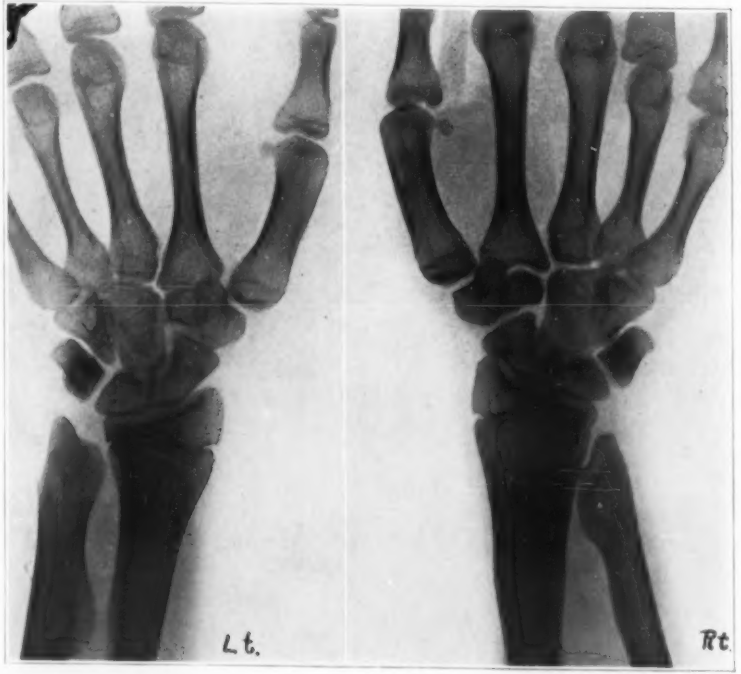


FIG. 8

Case 7. Anteroposterior views of wrists, taken on December 3, 1938 (five months after second resection of left radial head and four years and three months after original resection). Obvious proximal displacement of left radial shaft.

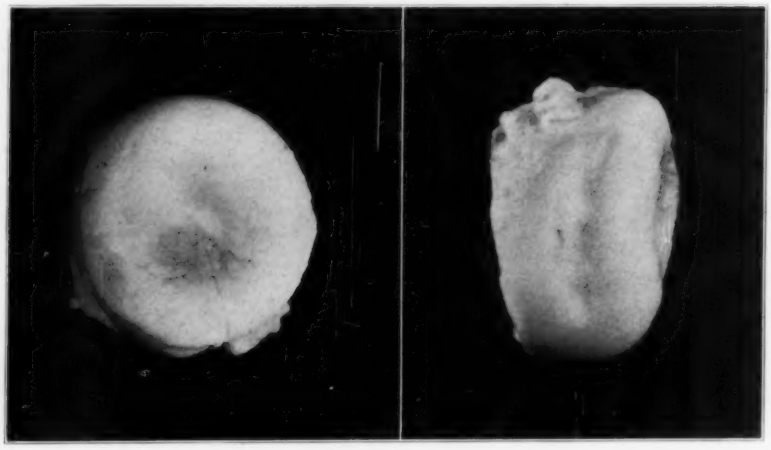


FIG. 9

Case 7. Anteroposterior and lateral aspects of dislocated left radial head excised on September 7, 1934. Articular cartilage on head thinned out and degenerated. (×2)

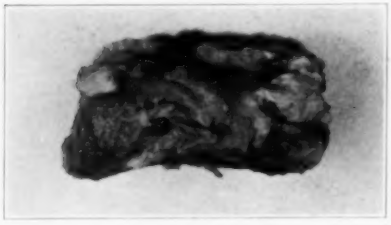


FIG. 10

Case 7. Proximal end of left radius excised on July 1, 1938, because of proximal displacement, following original excision of radial head on September 7, 1934. No appreciable bone formation grossly. (×2)

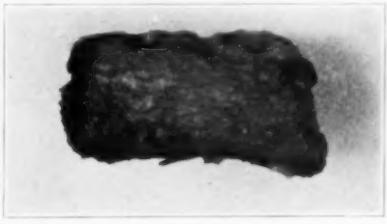


FIG. 11

Case 7. Sagittal section of same specimen shown in Fig. 10. (×2)

probably due, for the most part, to the flexion at the elbow. Nine patients had normal carrying angles.

Formation of "New Radial Head", or Bone Formation at Operative Site

Four of the thirteen patients had a second resection of the proximal end of the radius. In one instance, this was because of recurrence of a tuberculous involvement. In another case, caused originally by an ankylosis due to suppurative arthritis, the resection was done because of a bony ankylosis between the upper radius and the upper ulna, following the first resection. A similiar ankylosis recurred following a second resection. A third patient, with a dislocated radial head, due to multiple osteochondromata, was nine years of age at the time of the original resection. Four years later, the proximal end of the radius was again excised because of a persistence of its posterolateral dislocation (Figs. 10 and 11).

FIG. 13

FIG. 12

Fig. 12: Case 7. Proximal end of resected radial stump shown in Figs. 10 and 11. (×100)

Fig 13: Case 7. Proximal end of radial stump capped with fibrous connective tissue. (×300)

Five months after the second resection, roentgenograms revealed that a bony spur, one-fourth of an inch in diameter, was present on the dorsal surface of the radial stump. A fourth patient, with a fractured radial head, was fourteen years of age at the time of the original resection. Five years later, the proximal radial segment was resected again, because of a return of marked limitation of pronation and of supination. Seven months later, roentgenograms showed no appreciable bone formation.

In one case, twenty-eight months following resection, there was noted a malformed "new head" of moderate size; it did not cause objectionable symptoms. In another case, an irregular mass of bone formation, one-half by one-fourth of an inch in size, was present at the proximal end of the radial stump six years after resection.

In a third case, bony ankylosis of the radial stump to the ulna took place eighteen years after resection. In a fourth case, there was a bony spur, three-tenths by one-eighth of an inch in size, on the lateral aspect of the radial stump three and one-half years following resection. In a fifth case, there was slight calcification about the periphery of the radial stump three months after resection.

In only five of the thirteen patients did roentgenographic examination show no appreciable formation of bone at the operative site.

It is interesting to note that four of these five patients who showed no appreciable bone formation were beyond the growth period; they ranged from twenty-one to sixty years of age at the time of operation.

In one patient, bone formation, following excision at the age of fourteen years, was evident. No appreciable bone formation followed a second excision at the age of nineteen years.

Anterior Luxation of Radial Stump

None of the patients showed any clinical or roentgenographic evidence of this complication.

Pain, Weakness, or Tenderness at Wrist

Five patients complained of pain and weakness at the wrist, following resection of the radial head; three of these were tender to pressure over the distal radio-ulnar articulation of the involved extremity. The degree of disability was slight in three cases, moderate in one case, and severe enough in the fifth to prohibit the use of the hand for ordinary household duties; in this last case, a resection had been done two and one-half years previously because of a tuberculous involvement. Eight patients had no disability at the wrist.

Radial Deviation of the Hand

In one case (that of the patient with the acute symptoms at the wrist), there was a 10-degree radial deviation of the hand, which was passively correctable to neutral. The remaining twelve patients showed no radial deviation.

Prominence of Ulna at Dorsum of Wrist

Two patients presented a slight prominence of the lower end of the ulna at the dorsum of the wrist, and a third had a moderate degree of prominence. Ten did not show a prominence.

Motions at Wrist

In one wrist there was a slight limitation of ulnar deviation (adduction). Another wrist (the same wrist in which there was a severe degree of pain, tenderness, and weakness, and which was held in 10 degrees of radial deviation and in 10 degrees of palmar flexion) did not allow dorsiflexion or ulnar deviation, but permitted palmar flexion to 30 degrees and radial deviation to 15 degrees. In a third wrist motion in all directions was limited about 50 per cent., but in this case (tuberculosis of the elbow) plaster immobilization had just been discontinued, and so the limitation of motion is to be discounted. Ten wrists maintained full motion in all directions.

Proximal Displacement of the Radial Shaft

This complication is apparent in roentgenograms of the wrists. It occurred in all of the patients, with the exception of two, both of whom had a bony ankylosis of the proximal radial stump to the upper end of the ulna following resection of the radial head and neck. In one of these cases, the head had been resected because of a fracture-dislocation; in the other, resection was done because of a bony ankylosis following suppurative arthritis. This proximal displacement of the radial shaft varied from one-sixteenth to three-eighths of an inch.

In one case (not included in this group of thirteen cases) roentgenograms were taken three days after resection of the fractured radial head. With the hand in the neutral position at rest, there was no proximal displacement of the radius, but, when the hand was held in strong radial deviation, there was a proximal displacement of one-sixteenth of an inch.

Widening of Distal Radio-Ulnar Joint

This complication also occurred in all cases with the exception of the two cases of ankylosis of the proximal end of the radius and ulna and the case of congenital absence of the lower end of the ulna. A slight to moderate widening of the joint space is seen in the anteroposterior roentgenograms. This widening is in both a transverse and a longitudinal direction.

CASE REPORTS *

CASE 1. L. U. (No. 151864), male, sustained a fracture-dislocation of the left elbow in March 1932. Four months later, at the age of fourteen years, the upper one-half inch of the left radius was excised, because of posterior subluxation of the anterolateral fragment, with limitation of pronation to 10 degrees and of supination to 80 degrees.

* Positive findings only are included.

Examination in December 1938 showed pronation to 75 degrees, supination to 90 degrees, a carrying angle of 30 degrees, and elbow extension to 140 degrees. There was a slight prominence of the lower end of the ulna, and the radius was displaced proximally one-eighth of an inch. The distal radio-ulnar joint was widened. A moderate amount of bone formation was present at the radial stump. The patient complained of moderate pain and weakness in the elbow when carrying heavy objects, and of slight tenderness over the operative site. The result was fair.

CASE 2. N. B. (No. 136915), female, fractured the left radial head on March 9, 1931. The left radial head and neck were excised on July 19, 1933, at the age of fourteen years, because of loss of pronation and of supination. Because of bone formation at the radial stump, with limitation of pronation to 5 degrees and loss of supination, the proximal one and one-fourth inches of the radius were again resected on May 2, 1938, at the age of nineteen years.

Examination in December 1938 showed pronation to 20 degrees, supination to 80 degrees, a carrying angle of 15 degrees, and elbow extension to 175 degrees. There was slight limitation of ulnar deviation of the hand. A slight prominence of the lower end of the ulna was noted. The radius was displaced proximally one-fourth of an inch. The distal radio-ulnar joint was widened, with local tenderness. The patient complained of pain and weakness of moderate degree in the wrist when working. The result was fair.

CASE 3. J. K. (No. 29996), male, sustained a fracture-dislocation of the left elbow on October 10, 1918. When first seen, the patient could not pronate or supinate the arm, and 10 degrees of anteroposterior motion was present. An arthroplasty of the left elbow, with resection of three-fourths of an inch of the proximal end of the radius, was performed on July 20, 1920, at the age of thirteen years.

Examination in December 1938 showed the left forearm fixed at 25 degrees of supination, with no rotary motion. Anteroposterior motion of from 90 to 95 degrees was present at the elbow. The radial stump was ankylosed to the upper end of the ulna. The result was poor.

CASE 4. E. D. (No. 176413), female, fractured the left elbow in March 1934. There was loss of pronation; supination to 15 degrees was possible with pain. The left radial head and neck (upper one inch of radius) were excised on November 5, 1934, at the age of sixty years.

Examination in December 1938 showed pronation to 80 degrees and supination to 90 degrees. The radius was displaced proximally one-sixteenth of an inch. There was very slight widening of the distal radio-ulnar joint. The patient complained of slight weakness and pain in the left wrist, with use. The result was good.

CASE 5. E. R. (No. 184570), male, had obstetrical paralysis of the right arm, with posterior dislocation of the radial head. Examination showed pronation to 20 degrees and supination to 20 degrees. The right radial head and neck (upper one and one-fourth inches of the radius) were excised on August 2, 1935, at the age of twelve years.

Examination in December 1938 revealed pronation to 5 degrees, supination to 85 degrees, a carrying angle of 20 degrees, and elbow extension to 160 degrees. The radius was displaced proximally three-sixteenths of an inch. The distal radio-ulnar joint was widened. A malformed "new head" (moderate amount of bone formation at radial stump) was present. The patient complained of slight pain and weakness in the right elbow when carrying heavy objects. The result was fair.

CASE 6. F. V. (No. 126971), male, had obstetrical paralysis of the left arm, with posterolateral dislocation of the radial head. Pronation to 90 degrees was present; supination was lost. The left radial head was excised on November 2, 1938, at the age of eight years. The periosteum was sutured snugly over the radial stump.

Examination in January 1939 showed pronation to 90 degrees and supination to 15

degrees. The radius was displaced proximally one-fourth of an inch. The distal radio-ulnar joint was widened, and there was slight calcification about the radial stump. The result was good.

CASE 7. L. S. (No. 149917), female, with multiple osteochondromata, sustained a posterolateral dislocation of the left radial head. Examination showed pronation to 75 degrees and supination to 90 degrees. The left radial head was excised on September 7, 1934, at the age of nine years. The proximal end of the left radius continued to remain dislocated posterolaterally, necessitating a second excision on July 1, 1938, at the age of thirteen years.

Examination in December 1938 showed pronation to 90 degrees and supination to 90 degrees. The radius was displaced proximally three-eighths of an inch. The distal radio-ulnar joint was widened, and there was a bony spur, one-fourth of an inch in diameter, on the dorsal surface of the radial stump. The patient complained of slight weakness and pain in the elbow when carrying heavy objects, and also of slight tenderness over the operative site. The result was good.

CASE 8. L. C. (No. 192499), female, had tuberculosis of the left elbow with involvement of the radial head. The left elbow was arthrodesed on June 1, 1936, with excision of the radial head, at the age of fifty-three years.

Examination in December 1938 showed the left elbow ankylosed at 135 degrees, with 5 degrees of anteroposterior motion, pronation to 5 degrees, supination to 10 degrees, and a carrying angle of 20 degrees. The left hand was held in 10 degrees of radial deviation and in 10 degrees of palmar flexion. There was loss of dorsiflexion and of ulnar deviation at the wrist. The radius was displaced proximally one-fourth of an inch. The distal radio-ulnar joint was widened, with local tenderness. There was moderate prominence of the lower end of the ulna. Pain and weakness in the left wrist were severe enough to prohibit ordinary household duties with the left hand. The result was poor.

CASE 9. M. H. (No. 208645), female, had tuberculosis of the left elbow, with involvement of the radial head. The left elbow was arthrodesed on April 18, 1938, with excision of the radial head, at the age of twenty-one years.

Examination in December 1938 showed the left elbow ankylosed at 140 degrees, with a few degrees of springy anteroposterior motion, pronation to 15 degrees, and supination to 15 degrees. All wrist motions were limited 50 per cent. (plaster immobilization had just been discontinued). The radius was displaced proximally one-eighth of an inch. There was slight widening of the distal radio-ulnar joint. The result was fair.

CASE 10. M. W. (No. 173334), female, had tuberculosis of the right elbow, with involvement of the radial head. The right elbow was arthrodesed, with excision of the radial head, on September 7, 1934, at the age of fourteen years.

Examination in January 1939 showed the right elbow solidly ankylosed at 120 degrees, pronation to 80 degrees, and supination to 90 degrees. The radius was displaced proximally one-eighth of an inch. There was moderate widening of the distal radio-ulnar joint. The patient complained of slight pain and weakness in the right wrist when writing. The result was good.

CASE 11. J. D. (No. 129233), male, had tuberculosis of the left elbow, with involvement of the radial head. The left elbow was arthrodesed on May 22, 1930, with excision of the radial head, at the age of fifty years. A second arthrodesis of the left elbow was performed on November 11, 1930. The proximal end of the left radius was excised again on July 7, 1934, at the age of fifty-four years, because of recurrence of disease at this point.

Examination in January 1939 showed the left elbow ankylosed at 145 degrees, pronation to 75 degrees, and supination to 70 degrees. The radius was displaced proximally one-sixteenth of an inch, and there was slight widening of the distal radio-ulnar joint. The result was excellent.

CASE 12. W. M. (No. 177435), male, had ankylosis of the left elbow, due to suppurative arthritis. There was loss of pronation and of supination. The left radial head was excised on November 6, 1935, at the age of fifteen years, allowing pronation and supination of 45 degrees each. Ankylosis of the radial stump to the upper end of the ulna recurred, and, on February 15, 1937, one and one-half inches of the proximal end of the left radius was excised.

Examination in December 1938 showed the left elbow ankylosed at 95 degrees. The proximal ends of the radius and the ulna were again ankylosed in mid-rotary position. The result was poor.

CASE 13. V. S. (No. 184165), female, had congenital absence of the distal end of the right ulna, with posterolateral luxation of the radial head. Examination showed pronation to 20 degrees and supination to 60 degrees. The right radial head and neck were excised on July 22, 1935, at the age of thirteen years.

Examination in December 1938 showed pronation to 90 degrees and supination to 90 degrees. The radius was displaced proximally one-fourth of an inch. There was a small bony spur on the lateral aspect of the radial stump. The patient complained of clicking and momentary twinges of pain in the right elbow on rotary motion. The result was good.

END RESULTS

The end results were determined according to the following criteria:

Excellent—Functionally satisfactory pronation and supination, and absence of symptoms or of deformity at the wrist or at the elbow.

Good—Functionally satisfactory pronation and supination, and only mild symptoms or deformity at the wrist or at the elbow.

Fair—Functionally satisfactory pronation and supination, and only moderate symptoms or deformity at the wrist or at the elbow.

Poor—Functionally unsatisfactory pronation and supination, and severe symptoms or deformity at the wrist or at the elbow.

From a study of the case reports, it will be seen that an excellent result was obtained in one case, good results in five, fair results in four, and

TABLE II

ANALYSIS OF END RESULTS

Pathological Condition	End Results			
	Excellent	Good	Fair	Poor
Fracture		1	2	1
Obstetrical paralysis		1	1	
Multiple osteochondromata		1		
Tuberculosis	1	1	1	1
Suppurative arthritis				1
Congenital dislocation		1		
Total	1	5	4	3

poor results in three. Table II lists the end results according to the pathological conditions for which the resections were done.

DISCUSSION

It is evident that proximal displacement of the radial shaft occurs with great frequency, following resection of the radial head and neck. This complication arises because there is produced a loss of bone support at the elbow. The interosseous membrane, with its fibers running obliquely and distally from the radial shaft to the ulnar shaft, tends to prevent the radius from being displaced proximally. However, intrinsic forces of muscle pull (chiefly biceps brachii and brachioradialis) and extrinsic forces (such as are occasioned by pushing against some object with the hand) are great enough to allow a measurable stretching of the interosseous membrane. This proximal displacement of the radial shaft frequently results in stretching and in widening of the distal radio-ulnar joint (with production of pain, weakness, and tenderness at this point), and may well result in prominence of the lower end of the ulna at the wrist, in limitation of ulnar deviation at the wrist, and in radial deviation of the hand. In this group of thirteen cases, radial deviation of the hand was observed but once. This patient presented a proximal displacement of the radial shaft of one-fourth of an inch. Other patients in this group, with proximal radial displacements of one-fourth of an inch and three-eighths of an inch, did not present radial deviation of the hand. Because of the loss of the proximal segment of the radius, a cubitus valgus deformity may occur. The loss of the growth center of the proximal end of the radius, following resection in children, does not seem to account for any measurable shortening of the radius at the wrist; the adults in this series showed proximal radial displacements varying from one-sixteenth of an inch to two-eighths of an inch, while the group below twenty years of age showed displacements varying from one-eighth of an inch to three-eighths of an inch. An appreciable proportion of cases present varying degrees of bone formation at the site of resection of the radial head and neck, ranging from a small bony lip to an irregular mass of new bone, which grossly resembles a deformed radial head. The proximal displacement of the radial shaft alone cannot account for the "recurrence of a new radial head" following excision, since there is an irregular increase in diameter of the proximal end of the resected bone in many instances. The most probable explanation of the so-called "new radial head" is the recognition of the proximal displacement of the radial shaft after excision of the head and neck, plus a varying degree of bone formation at the resection site.

It would seem logical, therefore, to strive to prevent these two factors from occurring, in order to preclude the development of undesirable conditions at the elbow and at the wrist.

In order to prevent bone formation at the radial stump, the following points should have especial consideration:

1. Complete removal of all free or loosely attached bone fragments, periosteal shreds or strips, and capsular tissue at the time of resection.

2. Avoidance of stripping back the periosteum from the radial stump, unless the stripped-up portion of the periosteum is completely excised or sutured over the stump to form a limiting membrane.

3. Use of a free graft of fascia lata snugly approximated with purse-string sutures over the end of the radial stump to form a limiting membrane, in case the periosteum has not been used as such.

In order to prevent proximal displacement of the radial shaft, it is suggested that the soft tissues be snugly approximated with several interrupted purse-string chromic-catgut sutures to fill in securely the dead space created by the removal of the radial head and neck, as described by Key and Conwell. The annular ligament should be repaired. It might be of value to immobilize the wrist in maximum ulnar deviation for from two to three weeks following resection of the radial head and neck, in order to allow the formation of scar tissue to obliterate further the dead space which was closed in with interrupted purse-string sutures. A plaster cast, applied from the bases of the fingers to just below the elbow, would allow free pronation and supination; the arm could be supported with a sling, in order to keep the elbow flexed to a right angle and thus relax the biceps. After removal of the cast, daily active and passive ulnar-deviation stretching exercises would be in order.

It is generally agreed that operative or traumatic insults to the elbow region in a growing child often result in a moderate or marked degree of calcification and bone formation. It is noteworthy that four of the five patients in this group who showed no appreciable bone formation following resection were twenty-one years of age or older. It seems true, therefore, that resection of the radial head should be avoided, if possible, in the growing child or in the adolescent.

SUMMARY AND CONCLUSIONS

In the thirteen cases of resection of the radial head and neck which have been reported, the end results were excellent in one case, good in five cases, fair in four, and poor in three. The production of undesirable conditions at the elbow and at the wrist following this procedure is liable to occur in an appreciable percentage of cases.

The two chief factors which cause disability are bone formation at the operative site and proximal displacement of the radial shaft. These may be prevented or minimized by strict adherence to certain points in the operative technique and postoperative treatment, which the author has stressed.

The author is indebted to Dr. A. D. Smith for the inclusion of two of his private patients in this group of cases.

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KIENBÖCK'S DISEASE OF THE LUNATE

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The term "Kienböck's disease" indicates a condition in which the lunate undergoes a slow, progressive, but incomplete degeneration with absorption of necrotic bone lamellae, followed by fibrous-tissue replacement. Speed refers to it as a localized osteitis, or a traumatic osteomalacia. Robert Kienböck gave the first adequate description of this condition in 1910. His paper was based on a study of sixteen of his own cases, and of twenty additional ones collected from the literature. He noted the similarity of this condition in the lunate to that seen in the carpal navicular, described the year before by Preiser, in coxa vara traumatica (Legg-Perthes disease) and in post-traumatic spondylitis (Kümmell's disease). Since Kienböck's contribution, other articles have appeared from time to time, and more cases have been added. In 1923, Saupe listed the reported cases of Kienböck's disease as follows: Becker, twenty cases; Kienböck, sixteen; Guye, seven; Finsterer, six; and Saupe, one. Goldsmith, in 1925, reported three cases, and, in 1932, Mouat, Wilkie, and Harding wrote an excellent paper based upon a study of twelve cases. Perhaps this is the best article on the subject since Kienböck's original description. The condition is not common. Less than 100 cases have been recorded in the literature. It is probable, however, that often the diagnosis is not made because the symptoms are frequently not severe, and, unless roentgenograms are taken, the disease will not be recognized. At the Massachusetts General Hospital we have made the diagnosis five times.

ETIOLOGY

It is generally agreed that severe trauma is not necessary to produce necrosis of the lunate. In three of our cases there was a history of a direct blow resulting in immediate acute disability, and in two others there was no known injury. In all five, however, partial necrosis of the lunate resulted. In the series from the Royal Sheffield Infirmary, reported by Mouat, Wilkie, and Harding, seven patients gave a history of a severe blow or fall on the hand, while five could remember no definite injury. While most authorities agree that severe trauma is not necessary to produce Kienböck's disease, the writer feels that in the vast majority of cases there has been in the past an injury, either directly to the lunate or indirectly through the other bones of the wrist joint and the carpus. The nature of the trauma may be a crushing force applied to the bone, resulting in a fracture of the bony contour, or simply a contusion of the cartilaginous surfaces, or there may be a subluxation of the bone, which reduces spontaneously, but results in tearing of the dorsal ligament and

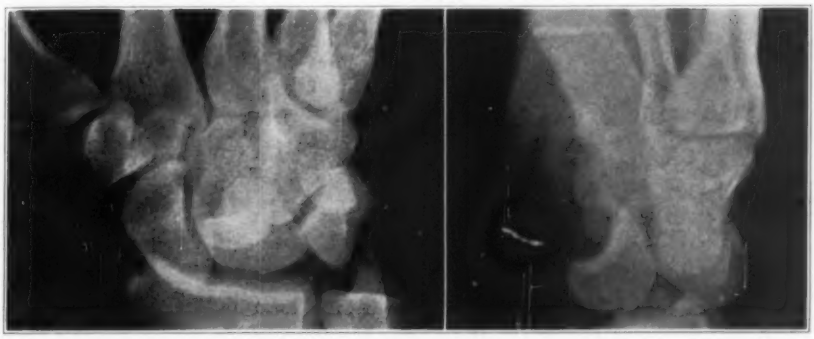

FIG. 1-A

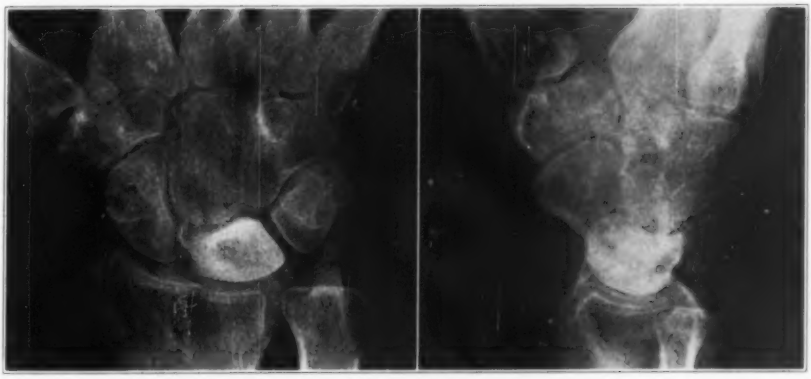

FIG. 1-B

Kienböck's disease developing after subluxation of the lunate.
Fig. 1-A: Anteroposterior and lateral views of the subluxated lunate.
Fig. 1-B: The replaced lunate, showing increased density, suggestive of aseptic necrosis.

subsequent interruption of the blood supply, followed by aseptic necrosis of the bone. So far as we are aware, however, in our series of twelve cases of dislocation of the lunate, there has been but one case in which Kienböck's disease subsequently developed.

R. Z., male, aged thirty-five years, injured his wrist in an automobile accident. He does not know in what position his wrist was held when it was injured. He was seen the day following the accident, and roentgenographic examination (Fig. 1-A) revealed a palmar dislocation of the lunate. After two attempts, under a general anaesthetic, the bone was satisfactorily replaced in its normal position. Six months later roentgenograms (Fig. 1-B) revealed increased density of the bone, suggestive of beginning sequestration, comparable to Kienböck's disease. Undoubtedly, the appearance was due to interruption of the blood supply to the bone at the time of injury.

The writer has been unable to find any comparable case in the literature.

McBride reported eight cases of old palmar dislocation of this bone, and, as far as could be determined, Kienböck's disease did not develop in any of these cases. In one of his cases the dislocation had been present for three years,—the average duration of the condition for the eight cases was twenty-six weeks.

Müller recognized three types of this disease: (1) the anatomical, due to abnormal pressure lines from anatomical anomalies; (2) the occupational, due to repeated minimal traumata; and (3) the traumatic, due to a single severe injury,—that is, acute fracture of the bone. It appears that there is no question that the essential cause is interruption of the blood supply with secondary necrosis,—whether it be a crushing of the bone or a subluxation resulting in interruption of blood supply through the ligaments.

PATHOLOGY

Kienböck states: "The operative findings show principally that the proximal part of the bone has crumbled into several pieces, the small fragments are only loosely held together by connective masses; at the site of the radiocarpal joint there is a yellowish, thickened connective tissue.

FIG. 2

Low-power view of section from excised lunate, showing necrotic bone lamellae.

The proximal part of the lunate is destroyed; the principal portion, with the joint surface for the navicular, the capitate, the hamate, and the cuneiform, is fairly well maintained. Sometimes the bone is broken into two about equal-sized pieces,—a volar fragment and a dorsal fragment."

In four of our five cases the diseased lunate was excised, but in only one case were histological sections made, so that we must rely somewhat on the observations of others for this phase of the subject. Köhler, in quoting from Kappis, stated that the microscopic findings were complete necrosis of the spongiosa, whereas there was good maintenance of nutrition to the distal portion especially for the joint surfaces of the capitate, navicular, and cuneiform. The English authors, Mouat, Wilkie, and Harding, obtained histological sections in three cases. A typical report is as follows: "No organisms found on bacteriological examination of the freshly excised bone, and cultures remained sterile. 'The bone shows marked changes. The marrow is replaced by fibrous granulation tissue, in places dense and in others younger and looser. The productive osteitis and osteochrondritis mentioned by Ewing are shown. The condition does not now seem to be active. It appears to be a form of osteitis fibrosa probably traumatic in origin. There is no microscopic evidence of infection.'"

In Case 5 of our series (S. D. P., No. 38540) the report on the microscopic sections was as follows: "Much of the articular surface is essentially negative, although patchy degeneration is evident. Immediately subjacent to the cartilage, however, along one entire edge of the bone, penetrating its substance for about one-half of its diameter, there is an extensive necrotic process. This varies considerably in its appearance. There are foci with complete necrosis consisting entirely of amorphous eosinophilic substance with relatively little exudative reaction. The under surface of the articular cartilage shows discrete shaggy areas of chondrolysis. Elsewhere in the osseous substance there are spicules of nonvital bone and an occasional focus of apparent new-bone formation. Save for the region of complete necrosis, the involved marrow substance exhibits dense fibrosis associated with a variable degree of lymphocytic and phagocytic infiltration. Several groups of foreign-body giant cells are observed." (See Figure 2.)

ROENTGENOGRAPHIC APPEARANCE

The roentgenographic appearance of these changes in the lunate is extremely important, because it is upon this one factor that the diagnosis is made. When do these changes occur? The answer to this question depends upon the severity of the original injury. It goes without saying that severe trauma to the wrist may result in fracture of the lunate. This injury may interfere with the blood supply to such an extent that necrosis may follow within a few weeks. If, however, the trauma is slight, it is probable that months or years may elapse before changes are visible in the roentgenogram. The changes are usually more marked at the

FIG. 3
Moderately advanced Kienböck's disease.

FIG. 4
Typical appearance of advanced Kienböck's disease.

proximal portion of the bone. In the anteroposterior view we may see early cyst formation and irregularity of the radial surface, with localized areas poor in calcium and others with a marked increase in calcium content. As the disease progresses, the bone becomes more dense, smaller, and irregular in outline, taking on the appearance of a sequestrum (Figs.

3 and 4). Usually it remains in this state,—a dead bone. In certain patients the destroyed portion of the bone becomes fragmented. This was true in some of Kienböck's original cases. In the lateral roentgenogram, the density of the bone is increased, and the proximodistal diameter of the bone is lessened, whereas the anteroposterior diameter is increased. (See Figure 3.)

SIGNS AND SYMPTOMS

The onset of the disease is insidious. Frequently there is no history of injury that the patient can recall. Other patients remember that their symptoms began with a severe strain of the wrist while lifting a heavy object; still others give a history of a direct blow on the wrist or a fall on the hand with the wrist in dorsiflexion. Characteristically, the disease occurs in young males who do heavy work. There may be a slow, but definite increase in pain, moderate stiffness, and thickening of the wrist joint. All symptoms are made worse by use, and improve with rest and support. Sudden forced motions may bring on severe pain.

On examination, the wrist is moderately swollen and thickened in the anteroposterior diameter. Thickening is most marked over the dorsum of the wrist in the central portion. Local tenderness is usually acute and sharply localized to the center of the dorsum of the wrist. The amount of limitation of motion varies greatly in the individual case. In the acute stage, active motion in any direction may be painful, and passive motion may be carried out only to a moderate degree. Dorsiflexion and palmar flexion are the motions most apt to be restricted, and in our cases ulnar deviation was more limited than motion to the radial side. Making a complete fist is often impossible. Finsterer has called attention to a shortening of the third metacarpal with the hand in fist formation. With the hand in this position, he found that tapping over the distal end of this metacarpal may produce pain in the region of the diseased lunate.

DIAGNOSIS

The diagnosis of Kienböck's disease depends primarily upon the roentgenogram. The history and examination make one only suspicious of the lesion. The changes from the normal, as shown by the roentgenogram, are confined to the lunate. The condition may conceivably be confused with tuberculosis; in fact, in one of our cases this was the diagnosis made by one of our roentgenologists. Tuberculosis, however, does not remain confined to one bone of the carpus, and there is probably more generalized atrophy of the bones of the hand and the wrist. In the case of tuberculosis, there is usually more synovitis of the wrist joint and local heat, possibly plus evidence of tuberculosis elsewhere in the body.

TREATMENT

If the diagnosis is made early—after a few weeks have elapsed—and before the degenerative changes in the bone have become advanced, conservative measures, consisting in support from a plaster or leather

wristlet, may help to restore nutrition to the bone and to prevent advance of the process. When the bone is permanently deformed, however, and has the appearance of an irregular sequestrum, or when it has disintegrated, the only logical form of treatment is excision. This operation should be done with great care and neatness to avoid trauma to surrounding structures. If the changes have remained confined to the lunate—that is, if traumatic arthritis of the wrist joint has not developed—we may expect good recovery of the wrist-joint function with little or no pain, after the diseased lunate has been carefully removed. This statement is substantiated by the fact that in six of seven operated cases reported by Mouat, Wilkie, and Harding, excellent results were obtained. In their remaining five cases, operation was not done, usually because of compensation factors. Of our five cases, in which there were longstanding symptoms—an average of thirteen months—operation was done in four. Two patients were completely relieved and were able to return to heavy work. The third was improved and had returned to work, but still had some pain in the wrist at the extreme positions. In the fourth case, because of compensation factors, the operation was not done. So far as is known, the patient was improved after wearing a wristlet for six months, but he was doing only irregular light work. The fifth patient was operated upon too recently to evaluate the end result.

CASE HISTORIES

CASE 1. J. D. (No. 282345), male, aged thirty-six, a tinsmith, was admitted to the Hospital on March 16, 1937. One year before, while lifting a heavy weight, he had injured the right wrist. There had been no acute disability requiring treatment.

Examination: There was some swelling on the dorsum of the right wrist; dorsiflexion and palmar flexion were slightly limited; and no local heat was present. The patient complained of pain on extreme dorsiflexion and palmar flexion; the grip of the hand was weak. The Wassermann reaction was negative.

Roentgenographic Report: "Thickening of the soft tissues about the right wrist, apparent irregularity in the appearance of the lunate, especially on the proximal surface, visible both in the anteroposterior and in the lateral views. Some atrophy of all bones. Appearance is that of some destructive process, maybe tuberculosis."

Operation: The lunate was removed, and the patient was discharged eighteen days later. Baking and massage were prescribed.

End Result: When seen one year after operation, the patient stated that he had returned to work soon after discharge from the Hospital. The wrist was better, but was still a little sore. He wore a bandage while working. Examination showed that the wrist lacked 10 degrees of dorsiflexion and 30 degrees of palmar flexion. Roentgenographic examination revealed that a few fragments of the lunate remained.

CASE 2. J. C. (No. 299182), male, aged forty-five, a laborer, was admitted to the Hospital on May 29, 1929. Six months previously, without known injury, he had begun to have pain in the left wrist. The pain was not acute, but it gradually became more disabling in his work.

Examination: There was no swelling or deformity. Although the effort was painful, the patient could make a fist; weakness in the grip was noted.

Roentgenographic Report: "Slight atrophy, no soft-tissue thickening, no narrowing of joint space. Lunate smaller and more dense than normal, with indefinite outline. Some abnormality of shape. Appearance suggests Kienböck's disease."

Operation: The lunate was removed, and the patient was discharged six days later. All apparatus was discarded twelve days after the operation.

End Result: At follow-up examination one year after operation, the patient reported that he had returned to work, using a pick and shovel, four months after operation. He had had occasional pain, but it had never kept him from work. Motions were the same in both wrists. When examined six years later, he had no complaint.

CASE 3. T. C. (No. 291086), male, aged forty-two, a leather worker, was admitted to the Hospital on May 9, 1928. Fifteen months prior to admission, he had fallen on the left hand. No roentgenograms were taken at the time. A splint and straps had been worn intermittently without relief. The patient had stopped working five weeks before admission.

Examination: Swelling of the dorsum of the wrist was noted, and motion in dorsiflexion and in palmar flexion was limited.

Roentgenographic Report: "Roentgenograms show a T-shaped fracture of the lunate with diminution in size of bone."

Operation: Through a dorsal incision, the lunate was excised, the bone being removed in three pieces.

End Result: When seen one year after operation, the patient stated that he had returned to less strenuous work four months after operation. He had no pain and felt that he could do any kind of work. Flexion was one-fourth normal, and supination and pronation lacked 15 degrees. The grip was good.

CASE 4. J. L. (Private Ward), male, aged thirty-six, a laborer in a stone quarry, twelve months before admission had been struck on the palm of the hand with a crowbar, and the hand had been forcibly dorsiflexed. The bar had also struck the patient on the left anterior chest, and he had not been able to return to his original work. The injuries had been treated as strain and contusion.

Examination: The wrist showed marked limitation of dorsiflexion and of palmar flexion, with local tenderness over the dorsum, and the patient could not make a complete fist.

Roentgenographic Report: "Old fracture of lunate with narrowing of proximodistal diameter and increased density of bone. The proximal and posterior borders show roughening with hypertrophic new-bone formation. The joint surface adjacent to the capitate and laterally is smooth."

Treatment: The patient was given a reinforced wristlet. At the end of three months, motions were greatly improved, but it was felt that he could not return to heavy work. One surgeon advised removal of the lunate, another advised against it.

End Result: Six months after treatment was started there was "almost" normal motion in the wrist, with pain at the extremes of motion. The wrist was weak, and the patient was doing irregular, light work, wearing the wristlet.

CASE 5. S. D. P. (No. 38540), male, aged twenty-three years, a shoe worker, was admitted to the Hospital on January 7, 1939. Twenty-one months before admission, the patient had been in an automobile accident, and the right hand had been forcibly dorsiflexed. Pain and limitation of motion had followed and had continued up to the time of entry. He had worn an anterior cock-up splint for eleven months, without definite benefit.

Examination: There was tenderness over the dorsoradial aspect of the wrist, and the grip was painful and weak.

Roentgenographic Report: "Right wrist: the lunate is unusually dense and shows a small, round area of rarefaction as evidence of old injury."

Operation: Through a dorsal incision, the lunate was excised, and the patient was given a leather wristlet.

Postoperative Course: When last seen two months after operation, slight pain was still present over the ulnar side of the wrist, but motion was increasing. Flexion and exten-

sion were one-half normal. There was some tenderness over the dorsum of the wrist. The patient was wearing a brace part of the time.

CONCLUSIONS

The cause of Kienböck's disease is very probably trauma and not infection. If the diagnosis is made early, before sequestration of the bone has occurred, prolonged immobilization of the wrist may effect restoration of the blood supply and promote healing. If, however, the condition is of months' or years' standing, and if disintegration of the bone has occurred, careful excision of the entire lunate should be done.

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THE METHODS USED IN HANDLING THE EPIDEMIC OF POLIOMYELITIS IN ONTARIO IN 1937 *

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In the autumn of 1937 there was a rather severe epidemic of poliomyelitis in the Province of Ontario. There were 2544 cases reported, but a good many more cases were not diagnosed at the time. Of the reported cases, about one-third were in the City of Toronto and its immediate neighborhood, and the other two-thirds were scattered throughout the Province, chiefly centered at three points,—Port Colborne in the Niagara Peninsula, Ottawa, and London. The epidemic was entirely unexpected, and it was some time before its severity was realized. It was by far the worst epidemic that had occurred in this region, and we had had no previous experience in handling such an alarming situation. When the epidemic started, there was no prearranged idea as to what should be done. A good many things were done, some of them good, but they were all arranged and carried out in great haste and with frequent changes. If another epidemic were to occur in the same district fairly soon, it could be handled much better than was this one, and it is thought that our experience may be of some help in epidemics in other places. It is not the author's intention to discuss the details of orthopaedic treatment or the results, but, rather, to describe the measures taken to provide adequate treatment for the exceptionally large number of cases.

The medical profession is not prepared to deal with a situation like this. Its members are able to do nearly all of the actual work, but they are not organized in a fashion that permits the making of any rapid decision or the division of the work so that it can be carried out efficiently. What is needed is some guiding hand to direct all the efforts in the right direction, to decide quickly what should be done, and to go about getting it done. One man alone is hardly enough, and an epidemic like this is too alarming and too urgent to justify the delay that would be caused by the attempt of any medical society to become organized in an executive capacity. It would seem that the most satisfactory way would be to have procedures directed and coordinated either by some established Government Department or by a fairly small group of men previously appointed and with some prearranged plans. Whoever does this directing should be able to assume a certain amount of authority and be able to obtain the funds that are necessary.

As the epidemic in question was scattered all over Ontario, this function was taken over from the first by the Provincial Department of Health. This Department, at the start, sent to every doctor in the Province a symposium on poliomyelitis, chiefly with respect to its diagnosis and

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treatment, prepared from a series of papers presented at a special meeting of the Toronto Academy of Medicine. It also kept these doctors informed about the arrangements that were being made for the care of the patients. It asked advice when needed, judged this advice, and decided on the procedures to be followed. Most of the procedures were originated and carried out by other people, but they were all passed upon and coordinated by the Department of Health, and the necessary funds were obtained from the Provincial Treasury. This Department was able to obtain the complete cooperation of all doctors, hospitals, and local Boards of Health, and it did its work without offending anyone.

The first consideration in an epidemic of any communicable disease is the best way of preventing the disease from spreading, and any procedure that holds out hope of protection is welcome. The preventive measure which seemed the most promising at that time was the spraying of the olfactory area by zinc-sulphate solution, as recommended by Schultz and Gebhardt and by Peet, Echols, and Richter. This method was used fairly extensively in the early stages of the epidemic, but no systematic records were kept. It was thought that if the method was carried out in an organized fashion, and if complete records were kept, something might be learned about its value as a protective agent.

In the City of Toronto a group of 4713 children between the ages of three and ten years were sprayed on two occasions about twelve days apart—between September 1 and 4, and between September 13 and 16—and all these cases were followed carefully.[3] A control group of 6300 children of the same ages, living in the same districts, but who had not been sprayed, were followed carefully in the same way. In comparing these two groups, any case of poliomyelitis that developed within six days of the date of the first spraying was not considered, and the comparison was continued only up to thirty days from the date of the second spraying. During this period there developed in the 4713 sprayed children ten cases of poliomyelitis, while in the 6300 unsprayed children there developed eighteen cases,—that is, the rate per thousand in the sprayed children was 2.1, and in the unsprayed children, 2.9.

Each child was sprayed only twice, and in this way the procedure used differed from that recommended by Schultz and Gebhardt and by Peet and his co-authors, who advised spraying on two or three successive days, and then at intervals of two weeks. The solution and the method of injection were exactly as recommended, and the spraying was carried out by trained otolaryngologists as carefully as could possibly be done under the circumstances. The number of patients sprayed was not particularly large, but it was large enough to show that the method as used did not provide any appreciable protection against the disease. This was very disappointing, as from what we know of poliomyelitis, there is very little hope of marked good being done by any treatment started after the nerve cells have become damaged. The main hope of overcoming this disease is to prevent it from occurring.

Convalescent serum was given in practically every case when the diagnosis was made before the paralysis appeared, and was injected intramuscularly in doses of fifty cubic centimeters. This serum was distributed by the Department of Health, and was kept available in different towns so that it could be obtained quickly anywhere. It was impossible to judge at all accurately the effect of the serum, but the general impression was that the patients to whom it was given had about the same amount of paralysis as those who did not receive it, and certainly most of the worst cases seen had had it. The only controlled attempt to determine its usefulness was made at the Children's Hospital on 100 consecutive cases, all diagnosed and admitted before any paralysis had developed. Of these, the alternate patients were given fifty cubic centimeters of serum and the others were given the same quantity of glucose solution. These patients were examined carefully at intervals, and it was found that the number of cases in which paralysis developed and the severity of the paralysis were approximately the same in the two groups. This series was not large, but it suggested that, if convalescent serum in doses of fifty cubic centimeters had any effect on the severity of the paralysis, this effect was certainly not striking.

In this epidemic there were a good many cases of respiratory failure. As a rule, the breathing began to fail about the fourth or fifth day of the illness, and became rather rapidly worse and, unless the child could be placed in a respirator in time, he died of asphyxia. At the onset of the epidemic there were only two Drinker respirators in Toronto and it was found that no more could be obtained quickly. A third one, rather crude, but very efficient, was made at the Children's Hospital within twenty-four hours. After that, twenty-nine more were assembled at the Hospital; all were of the Drinker pattern, but, in constructing the later ones, some minor improvements were made. By the time the peak of the epidemic was reached, the Province was well supplied with respirators. These machines are bulky, difficult to transport and to set up quickly, and must have a motor to suit the electric current available. It is, therefore, much better to bring the patient to the respirator than to take the respirator to the patient. If the doctor in charge of the case is aware of the danger of failing respiration soon enough, it is possible, as a rule, to transport the patient a distance up to 100 miles in comparative safety. Most of the respirators were set up and used in Toronto, but several were sent to other towns where the cases were very numerous, and one or two were sent to towns in the outlying parts of the Province to supply the needs in those districts.

Some types of respirators, which differed from the Drinker type, were designed and used, notably a celluloid jacket which was made air-tight around the body by a pneumatic collar at its upper and lower ends, and was operated by a pump over the chest and abdomen. This type had the advantage of allowing access for nursing and for treatment of the paralyzed limbs, but had the disadvantage of fitting closely at both ends, so

that the movement and change in pressure at each breath were apt to cause pressure sores. A special jacket had to be made to fit each patient, which took some time. This type can be made and used with advantage for patients who are on the way to recovery, but it cannot be kept ready for any patient whose breathing might commence to fail. The only type that can be kept available for immediate use for any size of patient is the Drinker respirator.

At the Toronto General Hospital and at the Children's Hospital thirty-nine patients were treated in respirators. Of these, twenty-two died with extensive bulbar involvement while they were in the respirator; in practically all of these cases death occurred within the first ten days. There are still three patients in respirators, and these have to be in the respirators for more than half the day. Fourteen reached the stage when they had recovered sufficiently to need the respirators no longer, but of these two have since died,—one suddenly from some unknown cause, and one from bronchopneumonia. Twelve are living with a respiratory apparatus good enough to stand any ordinary strain, but there is still present a varying amount of paralysis of other regions.

The results in the cases in which respirator treatment was needed were not good, and the question has been raised whether the saving of this small proportion of badly crippled children justifies the large expense and amount of care necessary. In this series of thirty-nine cases, the treatment has kept alive fifteen patients who would otherwise have died from asphyxia, and some of these are not very badly paralyzed. It would, therefore, seem that the use of respirators is justified.

If the respirators are used, some arrangement should be made to have them available in sufficient numbers when and where they are needed. It is a mistake to have to start making them when the cases of respiratory failure appear, and it seems unreasonable to keep a supply of these machines in every district where an epidemic might occur. It would seem wiser to have some central distributing point where a sufficient number of these machines could be kept ready and from which they could be shipped to the regions affected by the epidemic.

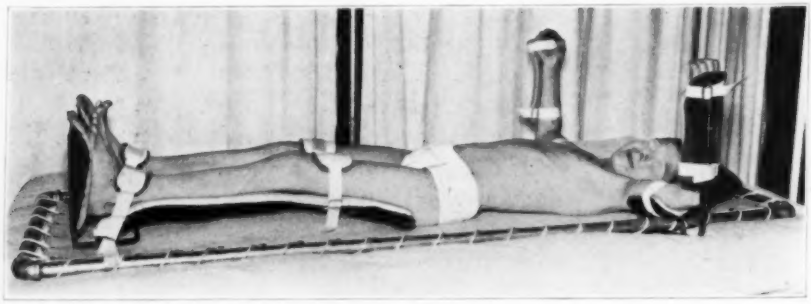

FIG. 1

Position in which limbs are held by standard splints.

For some years, we had been using splints in the treatment of poliomyelitis with the object of holding the paralyzed muscles relaxed, and of preventing deformities, and we had come more and more to the conclusion that the earlier the splints were applied, the better. We had been using either improvised splints or splints made especially for each individual patient by splint makers. The improvised splints were usually unsatisfactory, and it was soon found that the available splint makers could not begin to supply the demand within a reasonable time. It was thought that the best solution of the difficulty would be to have made a number of standard splints, in different sizes to fit any patient, which could be kept on hand and issued when needed.

To make this plan simple enough to work at all satisfactorily, it was necessary to limit to the minimum the number of different forms of splints to be made. A standard position (Fig. 1) was chosen in which both the upper and lower extremities were to be splinted, and only one shape of arm splint and one shape of leg splint were made. It was realized that these standard positions might not be ideal for every case, but as they held relaxed the muscles most commonly affected and most likely to be overstretched, they were, on the whole, satisfactory. Absolute immobilization was not necessary and, provided the splint was comfortable, it did not have to fit very accurately. It was found that a shallow-gutter type of splint, heavily padded, would fulfill all requirements. If such a splint was made to conform to the shape of the average limb, it would fit comfortably and efficiently almost any shape or thickness of limb of that length, and would fit either the right or the left limb. All that was needed, then, was to have a number of splints of different lengths, each length having its own corresponding width and contour; and to

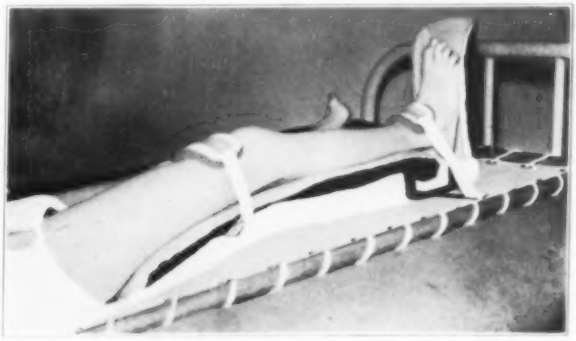

FIG. 2

Leg splint applied. The strap above the knee can be fixed at different levels by dome fasteners.

FIG. 3

Leg splint.

pick the right size of splint, only one measurement was necessary,—the length of the limb. To make the issuing of splints as simple as possible, it was requested that this measurement be taken between two definite fixed points. All the sizes of the splints were numbered, and a table was worked out so that from this measurement the proper size of splint could be picked out immediately. These splints were made at the Children's Hospital, and during the epidemic 749 leg splints and 316 arm splints were issued.

The leg splint (Fig. 2) was intended to hold the knee just short of complete extension and the foot at a right angle to the leg, and, with the patient lying flat on a frame, to hold the hip extended and to prevent the limb from rotating in either direction. It consisted of a leg piece and a foot piece joined together, with a gap at the heel, by a fairly heavy iron bar to which was fixed a cross bar to prevent rotation. (See Figure 3.) The leg piece and the foot piece were made of sheet aluminium of different thicknesses depending on the size of the splint. The shape of the leg piece was important, and to ensure uniformity each size was hammered out in a special metal mold. All the edges of the metal were bent over slightly, particularly at the lower end just above the heel, and, in order to avoid uncomfortable pressure on the femoral condyles, the splint opposite the knee was made narrow and flat. The foot piece was slightly wider than the average foot and slightly longer to prevent the bed clothes from resting on the toes, and it had a fairly high flange on either side. Both the foot piece and the leg piece were padded with heavy sponge rubber, which was cut slightly larger than the metal to overlap its edges. The rubber was cemented in place, so that it could not shift, and was so placed that no additional padding was needed. The covering was usually of leather, but for the smaller children it was found better to use a waterproof material.

These leg splints were made in lengths to fit any patient (Fig. 4) and, in all, eleven different sizes were made. For the smaller children with

FIG. 4

Complete set of different sizes of leg splints.

short thighs it was necessary to make the different sizes of splints with only slight variations in length, but for the larger patients a considerable difference in length was possible. When necessary, the position in which the foot was held could be altered by bending the bar.

FIG. 5
Arm splints applied.

The arm splint (Fig. 5) was intended to hold the shoulder abducted in a position of mid-rotation and to hold the elbow at about a right angle, with the forearm supinated and the wrist extended. It consisted of an upper-arm piece and a forearm piece, both made of sheet aluminium, padded and covered in the same way as the leg splint. The two were joined together, with a gap at the elbow, by an iron bar, which was continued under the edge of the Bradford frame, to which it was fixed by a clamp. (See Figure 6.) This bar was straight when the splint was made. The only measurement requested was the length of the forearm as measured from the tip of the elbow to the web of the thumb. From this measurement the right size of splint could be chosen, and, before the splint was issued, the iron bar was bent to correspond to the elbow joint. This bending made the forearm part of the splint fit the patient's forearm, and the length of the arm part could be adjusted when the splint was fixed to the frame by the clamp. This adjustment obviated the need of having many different sizes of splints, and it was found that three different sizes (Fig. 7) were enough to fit all patients. The angle at which the elbow joint was held could be easily altered by bending the bar. This arm splint could be used only when the patient was lying on his back on a Bradford frame.

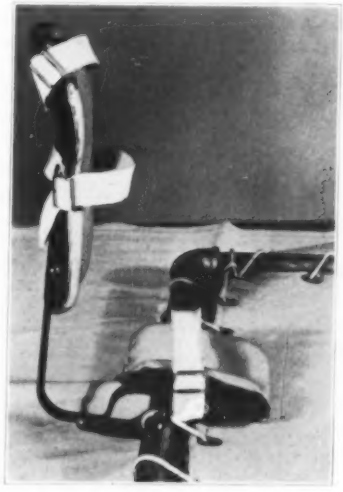

FIG. 6
Arm splint fixed to Bradford frame by clamp.

Besides the one type of arm splint and the one type of leg splint, a third appliance was issued,—the Bradford frame; this was recommended in cases where splints were used. These frames were made and kept in stock in different sizes, and to pick the proper size only one measurement was re-

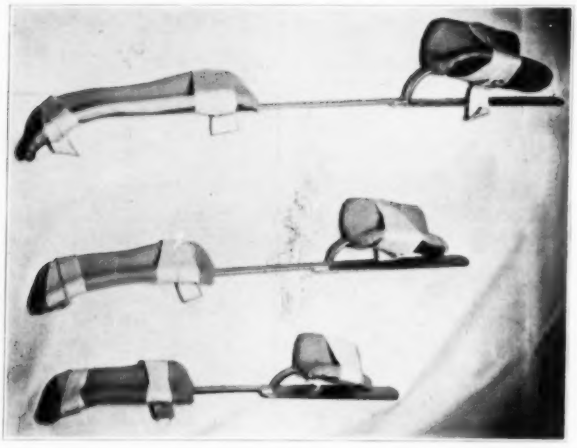

FIG. 7

Complete set of different sizes of arm splints. This type of splint is kept in stock with the bar straight. The bar is not bent until the measurement for the particular patient is obtained.

quired,—namely, the height of the patient.

These standard ready-made splints were very satisfactory, particularly as they were ordered and used largely by doctors with little or no orthopaedic training. It was very easy to obtain the right size. The necessary measurement was very simple and could be taken by anyone with reasonable certainty that the splint would fit. As the Provincial Government was supplying these splints, the usual delay about payment was eliminated. Every doctor in the Province had been informed what splints were available and how they could be obtained. All he had to do was to fill in a form with the name of the patient, the address to which the appliance was to be sent, the appliance wanted, and the necessary measurement. The appliance was sent out the same day, accompanied by printed instructions about its application. These splints were very comfortable, very simple to handle, and were efficient in accomplishing what they were intended to do. They can be made in large numbers fairly cheaply and the method is worth consideration in any epidemic.

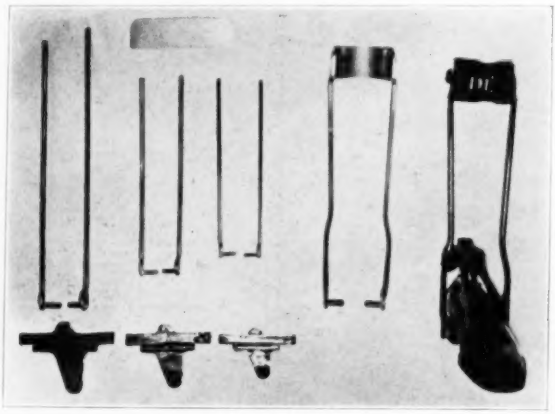

FIG. 8

Parts of ankle brace kept in stock in different sizes for immediate assembly and fixation to boot.

The same standard idea is being carried out in the making of braces for the patients when they get up. This is not as simple as the making of splints, as each brace has to fit more accurately and requires some individual fitting. Only two types of braces are made in this way, and these fulfill the requirements of most cases,—the double ankle brace (Fig. 8) with stop joints, and

the long leg brace (Fig. 9) with a half ring at the top, no joint at the knee, and either a free joint or a stop joint where it fastens to the boot. The various parts of these braces are made in different sizes and kept in stock, and, when the brace is made, these parts are altered slightly if necessary, and the brace is assembled more or less on the patient. (See Figure 10.) The main point in using this semi-ready method is to cut down the time that the patient has to be at the hospital. If a child is brought back to the Out-Patient Clinic and is considered ready to get up in a brace, a finished brace of either type, fastened properly to the shoe, can be provided easily within two hours' time. The child does not have to be admitted to have his brace made and he does not even have to return for a second fitting.

In such an epidemic, every facility available in a hospital should be utilized. As it was popularly supposed that the use of convalescent serum before the paralysis appeared would lessen the severity of the paralysis, an early diagnosis was considered essential. Except in very typical cases, it was impossible to arrive at a definite diagnosis before the paralysis appeared unless a lumbar puncture was done and a definite increase in the cell count was found. It was difficult for the general practitioner to do a lumbar puncture, and in Toronto two diagnostic clinics were established—one at the Isolation Hospital and the other at the Sick Children's Hospital—and to these clinics a large number of children were either sent by their doctors or brought by their parents. There they were

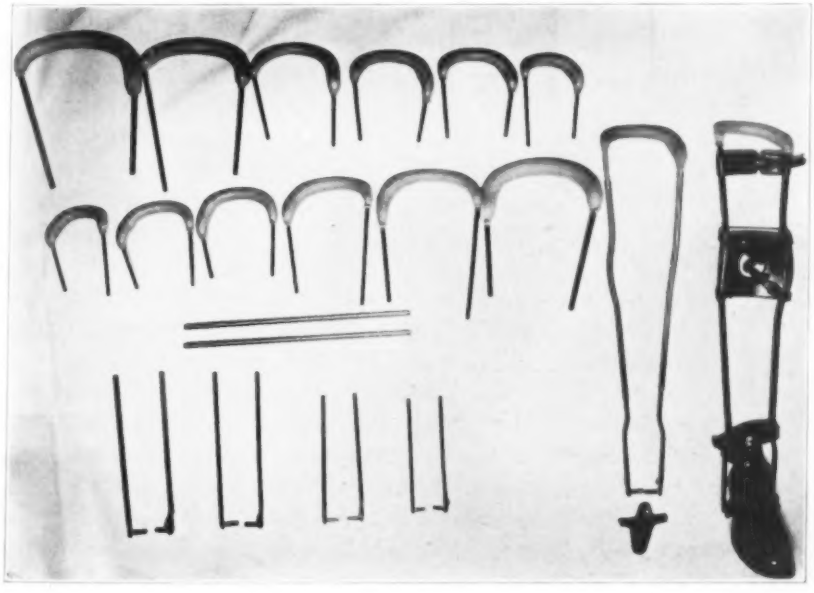

FIG. 9

Parts of long leg brace kept in stock in different sizes for immediate assembly and fixation to boot. The middle parts of this brace consist of tubes into which the upper and lower parts fit and are fixed by screws. This allows two levels at which the brace can be adjusted to accommodate for growth.

seen by men more or less familiar with the clinical picture of early poliomyelitis. In the doubtful cases lumbar punctures and cell counts were done, and, if a positive diagnosis was made, the patients were either admitted to the hospital or sent home under the care of their own doctors. The only objection to these clinics was that at times they were very crowded and it was difficult to prevent a certain amount of contact between children who did not have poliomyelitis and those who did. Otherwise the clinics were very satisfactory and were much appreciated and much used by the general practitioners. Similar diagnostic clinics were established in other towns in the centers of affected areas. It was found, however, that this sort of assistance was more needed by doctors in country districts where no hospital facilities were available. A number of district consultants were appointed by the Province,—fairly young men who had finished their internships, and most of whom had had some neurological training. These men were given a short but intensive course on the diagnosis of poliomyelitis, the doing of lumbar punctures and cell counts, the handling of the cases in the early stage, and the necessary splinting. They were then supplied with cars, the equipment needed to do lumbar punctures and cell counts, and convalescent serum, and were sent out to the different country districts. They had no definite authority, but they could be called in by any doctor in that district who wanted to get a lumbar puncture done, or who needed help or advice. They were of great assistance and, as a matter of fact, most of them saw nearly every case that seemed at all suspicious in their district.

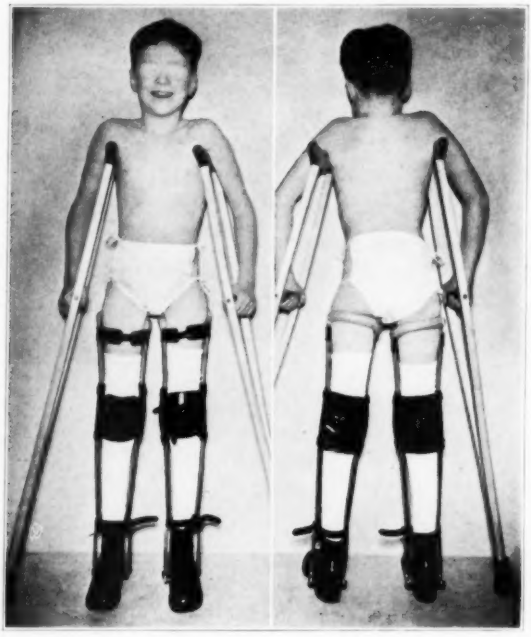

FIG. 10
Long leg braces applied.

There is some doubt about the need of routine admission to a hospital in the early stages of the disease. In Toronto nearly all of the patients were admitted to a hospital for their quarantine period of three weeks. In other large towns several patients were treated in hospitals, but in the smaller towns and in the country these children were treated in their homes, unless some emergency developed. The Public Health Nursing Service

was mobilized and all these children were visited, and in a good many cases most of the general care was supervised by these nurses. Apparently, with the necessary help, most of the average cases can be cared for at home in this stage about as well as they can in a hospital. In an epidemic, it does not seem reasonable to overload the ordinary hospitals with these cases, but hospital beds should be available for patients when the home conditions are bad, when the pain on movement is severe, or when the paralysis is extensive.

The treatment of these patients, after the quarantine period, was quite a problem. Many of them would have to be under treatment for a long time, and it was out of the question to keep them all in hospitals. Most of them would have to be treated at home, and it was thought that the treatment there would be improved by a course of training for both the patients and the parents. The Department of Health opened up the Ontario Orthopaedic Hospital with the object of getting the children accustomed to living very much altered lives and to teach the parents how to care for them. Every child in the Province who had any muscle paralysis was given the opportunity of being in this Hospital for three weeks, and a large number took advantage of it, particularly the ones severely paralyzed. These children were admitted to the Hospital, fitted with splints when this had not already been done, and treated by physiotherapy. They were taught how they should wear the splints, what they should do and what they should not do, and how to keep themselves occupied and amused. Three weeks is perhaps unnecessarily long for the older children, but for the younger children, who are much more difficult, it is hardly long enough.

The arrangements for the instruction of the parents in the care of the children at home were made difficult by the fear that contagious diseases might spread in the Hospital among children of this age, and, until two days before their discharge from the Hospital, the children were not visited by anyone except the hospital workers, and these all wore gowns and masks. Two days before they left the Hospital the children were transferred to "discharge wards", and during these last two days each child was looked after entirely by one parent, usually the mother, who did everything for him under constant supervision and instruction. She washed him, dressed him, made his bed, fed him, brought him the bed pan, took his splints off, gave him the necessary massage and passive movements, and put his splints back. By this time, the child had a pretty good idea of what should be done and was very much impressed with the need of wearing the splints properly and of avoiding overstretching of the muscles; usually the child and parent cooperated very well. This short intensive course of instruction probably succeeded in teaching the parents more about looking after their children than would have been accomplished by a much longer course, consisting chiefly of visiting and watching, combined with lectures and demonstrations. It was thought, however, that the time of instruction might have been increased to three days with advantage.

This training period in the Hospital, after the acute stage, was quite a success, and in most cases the routine care and treatment were continued at home surprisingly well. The "discharge wards" were so useful in training the parents that it was thought that the same idea could be carried out with advantage in any children's hospital where a child was being discharged and needed some special care or treatment carried out at home.

After leaving this Hospital, the majority of the children went home. If the home conditions were bad, or if the paralysis was extensive, they were transferred to wards arranged in another hospital, and a good many of the severe cases are still there under treatment. The treatment of the patients who went home was supervised by their own doctors working in conjunction with the Out-Patient Departments of the hospitals. The actual general care was assumed by the parents, who had to adjust the splints and to do the necessary massage and movements. These children were visited by the Public Health nurses and, when it seemed necessary, by physiotherapists. They were examined fairly frequently by their own doctors and were sent to the Out-Patient Departments at intervals. Those who lived in town reported to the clinics fairly frequently, but those who lived some distance away were sent down by their doctors when some change in treatment seemed indicated. On each visit to the hospital, the way in which the mother was doing the massage was checked up, any necessary repairing of the splints was done, and the doctor in charge of the case was written to about subsequent treatment.

On the whole, this method worked out very satisfactorily. Perhaps the treatment at home was not carried out quite as efficiently as if the child had been in a hospital all the time, but it was carried out surprisingly well. If the treatment was obviously being done badly, even with increased help and supervision, the child was admitted to a hospital, but there were few cases when this was thought necessary. One of the most pleasing points about the whole system was the way in which everyone cooperated. All the doctors had about the same idea as to what should be done and worked together in seeing that it was done, and as a rule the parents and even the children made an effort to do what they could toward carrying out their part.

The treatment of the paralyzed patients is not yet finished. They will continue to report at intervals to the Out-Patient Departments and at any time can be admitted for the necessary orthopaedic operations.

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THE ETIOLOGY OF SPONDYLOLISTHESIS

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It is a generally accepted teaching that spondylolisthesis is due to a congenital defect because of non-fusion of the centers of ossification of the fourth or fifth lumbar vertebra. It is a fact that in spondylolisthesis the responsible factor is a separation of the neural arch between the superior and inferior articular processes. It is not a fact that the separation of the neural arch is the result of a non-fusion of anomalous ossification centers; it is a conjecture.

Willis examined 1520 human skeletons, of which he found a separate neural arch in seventy-nine,—an incidence of 5.2 per cent. Shore studied eighty-two skeletons of Bantu natives in South Africa and found five specimens with a separate neural arch,—an incidence of 6.09 per cent. Congdon examined 200 skeletons of the American aborigines, in which there were ten cases of bilateral separation of the neural arch. Summing up these series, widely scattered both in time and space, the separate neural arch was present in 5.2 per cent. of 1802 cases.

Clinically, the incidence of spondylolisthesis is indicated by Meyerding, who reported a series of 583 cases, of which eighty-one were seen in a single twelve-month period. The incidence of spondylolysis, or separation of the neural arch without slipping of the vertebra, is, of course, higher than its clinical recognition, as indicated by the examinations of skeletons already cited.

With regard to its congenital origin, the problem of spondylolisthesis is very simple. If the separate neural arch occurs in 5 per cent. of fully developed skeletons, and if this separation is on a congenital basis, then this defect will occur in at least 5 per cent. of foetal or newborn skeletons.

There are three primary centers of ossification in the lumbar vertebrae,—one for the body, and one for each half of the neural arch. These centers appear at about the eighth week. The posterolateral portion of the body, the pedicle, the transverse process, the articular processes, the lamina, and one-half of the spinous process develop from the center for each half of the neural arch. The centers for the neural arch fuse posteriorly at term or during the first year of extra-uterine life. Failure of fusion posteriorly results in spina bifida. The neural arch fuses to the body of the vertebra from the fourth to the sixth year. Figure 1 traces the normal development of the primary ossification centers from the end of the third month to term.

To explain the development of the separate neural arch, it has been posited that there are two ossification centers for each half of the neural

* Orthopaedic Service of Carl E. Badgley, M.D.

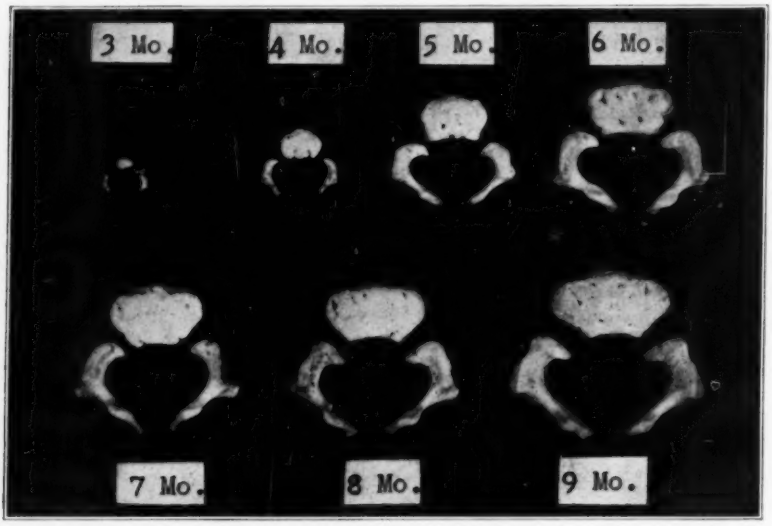

FIG. 1

The primary ossification centers of the fifth lumbar vertebra at various stages of their prenatal development. There is one ossification center for each half of the neural arch. The specimens shown are actual size.

arch. Failure of fusion of these two homolateral centers is supposedly responsible for the solution of continuity between the superior and the inferior articular processes. Thus, in a bilateral separation of the neural arch, the posterior portion of the vertebra is composed of the inferior articular processes, the laminae, and the spinous process. Figure 2 shows a fifth lumbar vertebra with separation of the neural arch.

Mall, in a series of sixty embryos less than 100 days old, found no evidence of accessory centers in the neural arches.

Willis, in 1929, in an analysis of vertebral anomalies, stated: "Neugebauer ascribed the condition [separate neural arch] to lack of fusion between two centers of ossification existing in each lateral half of the neural arch. . . . Neugebauer's theory would be sufficient if his postulated double centers of ossification were actually found. I have not yet discovered embryological confirmation thereof in study of specimens or in literature."

In 1931, Willis reported a study of foetal spines, with the object of demonstrating double ossification centers for each half of the neural arch. In no instance did he find such evidence.

Junghanns made the following statement: "But for this assumption of abnormal splitting of the bone nuclei of each half of the arch there was found no corresponding anatomic foundation in the examination of numerous spinal columns of the newborn."

Chandler's observations on a series of nineteen embryos failed to reveal any evidence of more than one ossification center for each half of a neural arch.

Since Willis's last report in 1931, no further studies on foetal spines have been reported.

To determine the incidence of anomalous centers of ossification in the lumbar vertebrae, the author undertook a study of 200 foetal spines. The age of the foetuses was determined by the crown-rump measurements of His. The smallest specimen was a foetus of approximately three months, the largest was a fully developed newborn infant. The lumbar and sacral spine was removed from each specimen, and the bodies of the lumbar and upper two sacral segments were removed at the cartilaginous junction of the bodies and the pedicles. A roentgenographic examination of each specimen was then carried out. Oblique views were obtained bilaterally at an angle of approximately 35 degrees from the mid-line, with a tube distance of thirty-six inches. Figure 3 represents the roentgenographic findings on three specimens at three, six, and nine months, respectively.

It will be noted in Figure 3 that in the lumbar region the ossification center for each half of the neural arch decreases gradually in size from the first segment to the fifth. There is an abrupt change in the size and contour of the first sacral segment, the ossification center being considerably smaller, and the development of the lamina much less massive. In the two larger specimens, anterolateral to the sacral ossification centers can be seen the centers for the costal elements, which are not present in the lumbar region. At three months, the so-called "isthmus" or pars interarticularis is not evident. At six months, a constricted area can be noted, and, at nine months, the isthmus is well developed. The formation of the isthmus is not, as has been commonly supposed, at the junction of two separate ossification centers. The formation of the isthmus is caused by the widening of the ossification center below that point, which, in turn, is due to the development of what is later to be the inferior articular process. The sacral segments do not show the development of an isthmus, because there is no development of

FIG. 2

A fifth lumbar vertebra showing spondylolysis or separation of the neural arch. The continuity is broken between the superior and inferior articular processes, at the level of the isthmus. The posterior segment is composed of the inferior articular processes, the laminae, and the spinous process.

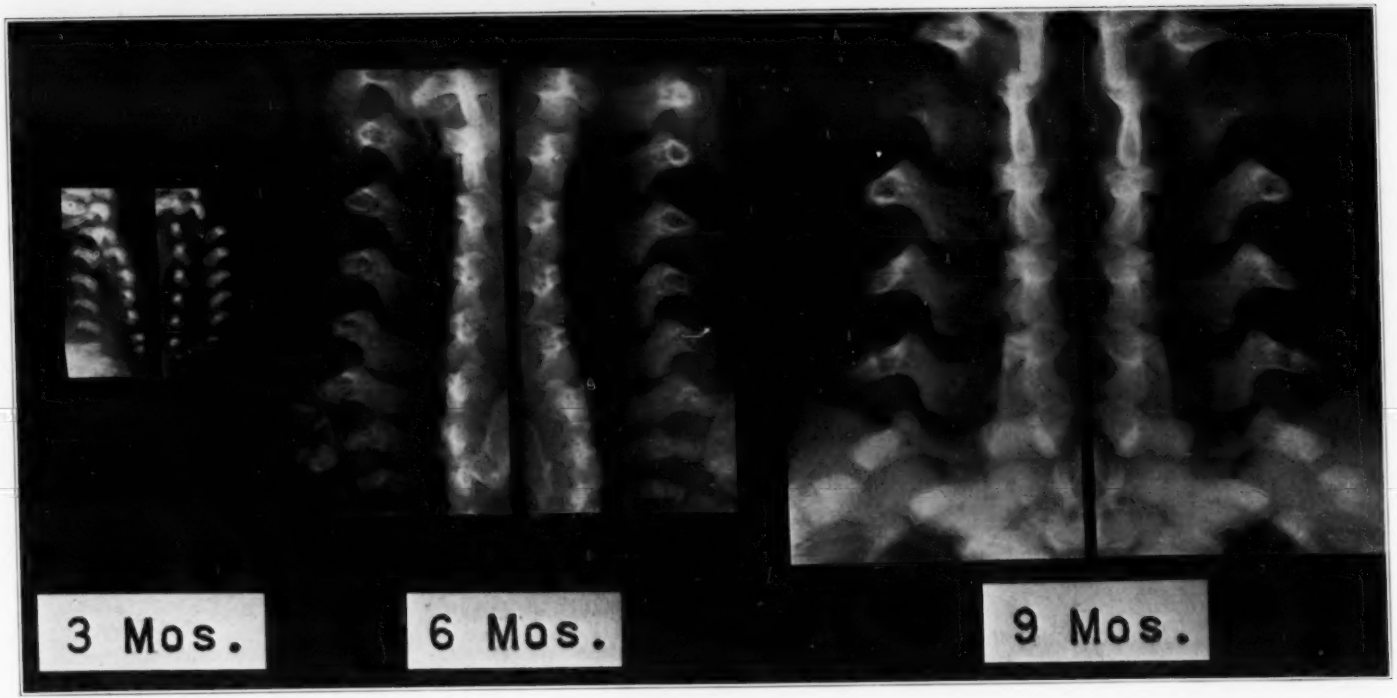

FIG. 3

Oblique roentgenograms of the lumbar and upper sacral segments of foetal spines at different stages of their development. The bodies of the vertebrae have been removed. The constricted portion at about the middle of the ossification center is the area where separation of the neural arch occurs in later life.

an inferior articular process.

This description applies to the normal development of the ossification centers for the neural arches in the lumbar and the upper sacral segments. Since separation of the neural arch in the adult is supposed to be due to the failure of fusion of two centers where there is normally only one center, a careful search was made for such anomalous centers. In the entire series of 200 foetal spines examined, there was not a single instance of a double ossification center for a half of a neural arch in either the fourth or the fifth lumbar vertebra, where separation of the neural arch occurs in 5 per cent. of adult skeletons.

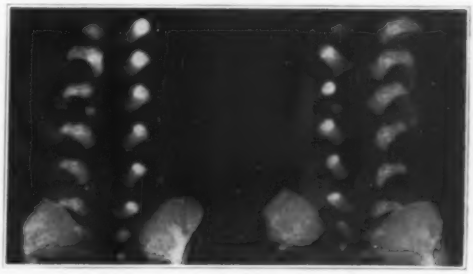

FIG. 4

The single specimen in a series of 200 observations which showed a double ossification center. This occurred on the right side only, and at the level of the third lumbar vertebra.

Examination of the entire lumbar spine in this series showed only one instance of an accessory center of ossification in a neural arch. This occurred on only one side in a third lumbar vertebra, as shown in Figure 4. This is the first authentic description, so far as is known, of the occurrence of such an accessory ossification center. Whether this center would have failed to fuse on either one side or the other, of course, can never be determined. It was impossible from a study of the specimen to determine whether, in the event of subsequent non-fusion to the remainder of the ossification center on that side, the defect would have been at the isthmus or pars interarticularis. Hence, to single out this finding to support the theory of the congenital origin of spondylolisthesis is not justifiable.

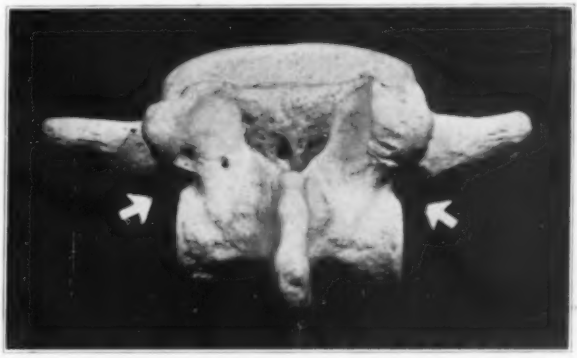

FIG. 5

A normal fifth lumbar vertebra, showing the "isthmus" (pars interarticularis) between the superior and inferior articular processes, the site of separation of the neural arch in spondylolisthesis.

Conclusions based upon purely negative evidence are seldom made with absolute finality. It is possible that in a series of 200 observations the negative evidence may be explained on the basis of an accident of sampling. Therefore, whatever conclusions are drawn must be contingent upon the laws of probability. Given the fact that separation of the neural arch in the fourth or the fifth lumbar vertebra occurs in 5 per cent. of adult skeletons, and given the fact that this is the result of a congenital

failure of fusion of anomalous ossification centers, then this lesion will be found in 5 per cent. of foetal spines, or ten times in a series of 200 foetal specimens. What is the probability that the lesion will be missed 200 consecutive times, if it occurs in 5 per cent. of all cases? It is approximately one out of 28,550 times.* In other words, if 28,550 observers each examined 200 specimens, only one would be able to record the results obtained in our series. Thus the proponent of the congenital theory may be correct, but such a probability is extremely remote. Nor should the weight of evidence furnished by previous studies be ignored. The numbers of the series reported by Junghanns and by Willis have not been recorded. When the sixty cases of Mall and the nineteen cases of Chandler are combined with our series, the figures become practically astronomical,—one to over 1,000,000.

It may be proposed that spondylolisthesis develops on a congenital basis because of the inherent weakness at the isthmus of the neural arch, the isthmus being developed before birth. Figure 5 represents a normal fifth lumbar vertebra, showing the narrow isthmus between the superior and the inferior articular processes. This is not what is usually meant when reference is made to the congenital origin of spondylolisthesis. In this sense, fractures of the neck of the femur might be assigned a congenital origin, because the neck of the femur is congenitally the weakest part of that structure.

CONCLUSION

Whatever may be the etiology of spondylolisthesis, it is probably not on the basis of a congenital defect.

The author wishes to express his sincere appreciation to Dr. Rollo E. McCotter, Professor of Anatomy, who furnished the anatomical specimens, and to Dr. Fred J. Hodges, Professor of Roentgenology, who provided the facilities of his Department for this study.

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* This value was obtained by means of the binomial expansion $(p+q)^n$, where p is the chance that the event will occur and q is the chance that the event will fail to occur; the values in this case are 1/20 and 19/20, respectively. The last term of the expansion, q^n, gives the probability of zero occurrences in a sample of n members.

THE USE OF INSULIN AS AN ADJUNCT IN THE TREATMENT OF BONE AND JOINT TUBERCULOSIS

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The successful management of cases of bone and joint tuberculosis is contingent upon the improvement in nutrition and in the general health of the patient. Convalescent hospitals have been built in almost every section of the country where patients with bone and joint tuberculosis, either in conjunction with operative procedures or for conservative management alone, may be maintained in an environment in which rest, balanced diets, fresh air, and sunshine are emphasized.

Even under these supposedly ideal conditions, many patients suffering from bone and joint tuberculosis fail to gain in weight. Although the local lesion may remain quiescent or show evidence of healing, such patients are listless and without appetite or interest in their food. Because some of the children suffering from bone and joint tuberculosis, who received care in a convalescent home affiliated with the University of Chicago, failed to gain in weight, insulin therapy was recommended. Fourteen patients with tuberculosis and one with bilateral Legg-Perthes disease, from three to thirteen years of age, were selected. To each of these patients, from two to five units of insulin were administered twenty minutes before each meal. In each case the patient manifested more interest in his food. For the first time, some complained that they were hungry. Twelve of the fifteen patients gained from one to three pounds in weight. In three of the twelve cases there was no consistent weight gain until after the injections had been discontinued. The results of the treatment are well demonstrated in the weight charts (Figs. 1, 2, 3, 4, and 5).

DISCUSSION

Insulin in the treatment of inanition in non-diabetic patients has been widely used since Pitfield in 1923 reported that two infants so treated gained in weight and in general health. Allen, Blotner, and Ellman also made clinical tests of insulin therapy in older patients with tuberculosis, generalized arthritis, or unexplained malnutrition, and reported improvement in appetite, in weight gained, and in general appearance of well-being.

The mechanism by which insulin seems to bring about a better state of nutrition has not been well understood. Freyberg believed that the improvement in appetite accompanying insulin administration was a psychological manifestation. Indirectly, this conclusion is supported by the recent work of Scott, Scott, and Luckhardt, who found that there was

no consistent change in the blood-sugar level of normal individuals preceding or during the occurrence of hunger contractions in the stomach. Although Quigley and his coworkers demonstrated that a lowered blood-sugar level would follow the administration of from twelve to twenty units of insulin, and that there was also an associated increase in gastric motility and in subjective hunger sensation, the work of the Scotts and of Luckhardt casts doubt upon the theory suggested by the earlier investigation of Carlson and his coworkers,—namely, that a lowered blood-sugar level is the cause of the increased appetite.

On the other hand, Okada and his coworkers have demonstrated that decrease in blood sugar below the normal level does produce an increase in the absolute amount of gastric, biliary, and pancreatic secretions. Lueders and Watson have reported a measurable increase in the potency of the pancreatic enzymes following the administration of insulin. They have further demonstrated a reduction of the digestive secretions and a diminution of gastric motility when glucose is placed in the duodenum or is administered intravenously. Lueders has also found evidence of improved digestion from examination of the stools of patients before and during insulin treatment.

SUMMARY

An analysis of the results of insulin administration to fifteen patients with bone and joint tuberculosis affords some evidence that, in selected

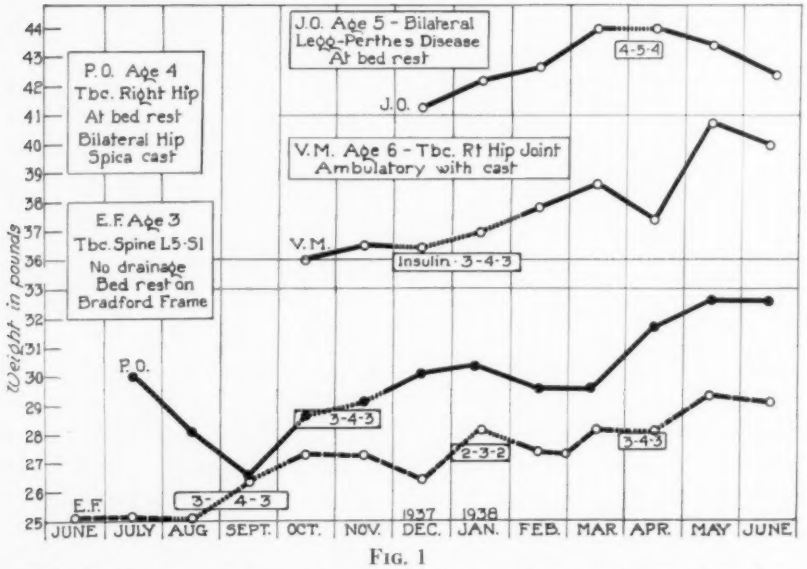

FIG. 1

This chart illustrates the weight curves of four patients aged three, four, five, and six years. Each of these patients was given 2–3–2, 3–4–3, or 4–5–4 insulin units daily.

All patients took a greater interest in their food, and over a period of from six to twelve months three of the children showed a satisfactory weight gain. This weight improvement could not be specifically attributed to the administration of insulin.

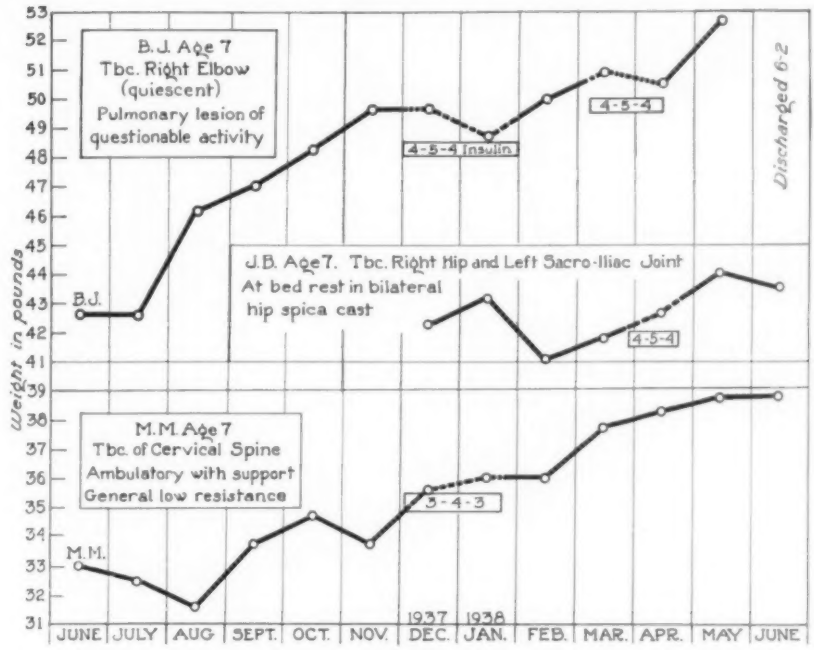

FIG. 2

Three patients, each aged seven years, were given insulin daily, as indicated, because they failed to manifest normal interest in their food. In each case, improvement in appetite was noted, and the favorable weight curve was maintained, but not definitely improved, by these injections.

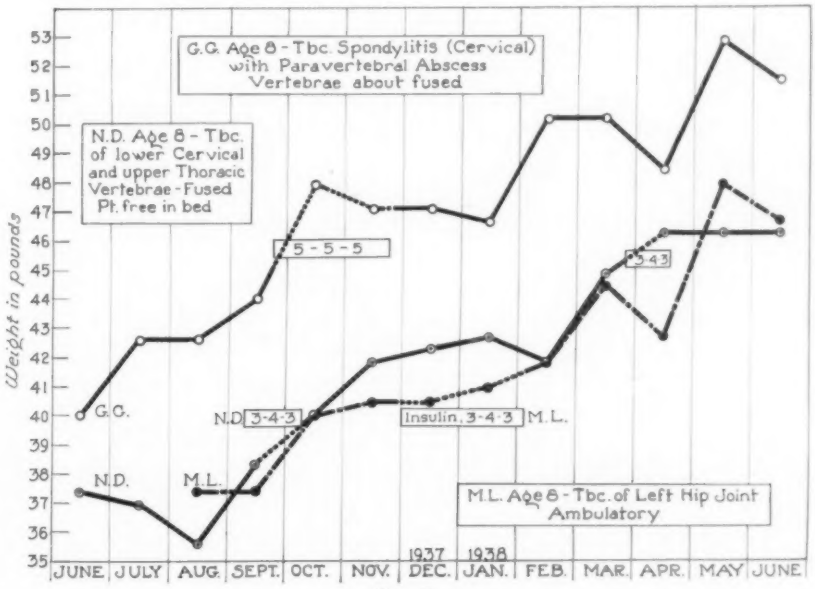

FIG. 3

Three patients, each aged eight years, suffering from tuberculosis of the bones and joints, show what may be interpreted as a favorable weight-gain response to insulin therapy.

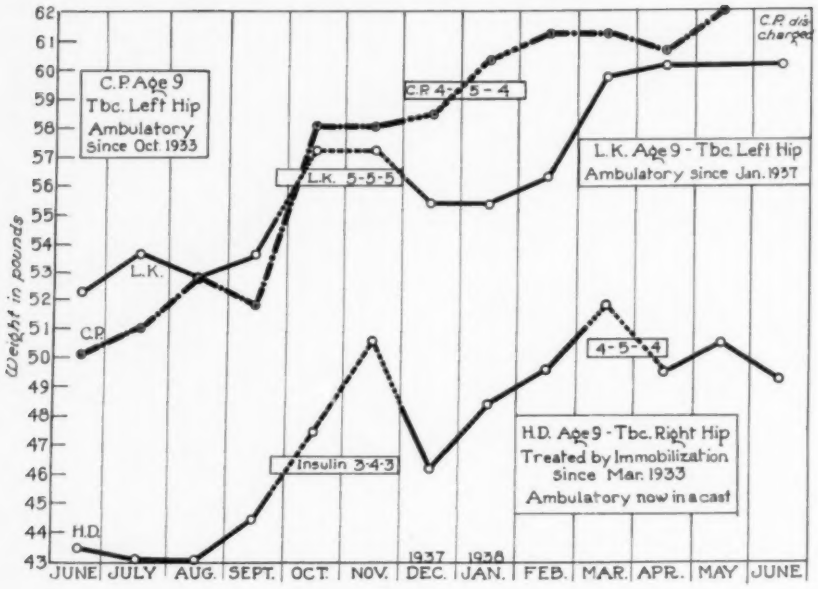

FIG. 4

Three patients, each aged nine years, suffering from tuberculosis of the hip, were given insulin injections for from five to ten weeks. The general appearance of the patients and their appetites or interest in food improved.

In the case of H.D., the consistent weight gain was interrupted during the course of insulin therapy by an acute upper respiratory infection in November 1937, and again in March and April 1938, and loss in weight occurred, although insulin was being administered.

cases, may justify this therapy. The younger patients, who were given a well-balanced diet in an environment considered to be most conducive to the treatment of bone and joint tuberculosis, showed an average improvement in weight, which would not seem to be specifically affected by the injected insulin.

All of the patients did show greater interest in their food, so that no urging was necessary in order to persuade them to eat their regular meals. There was a simultaneous improvement in the general appearance of well-being, which those who were in immediate attendance attributed to the insulin therapy. The most definite evidence of a specific response with respect to gain in weight which attended and followed the insulin injections was in the cases of two older children, aged eleven and thirteen years, whose general course had not been at all satisfactory prior to beginning this treatment. While both of these children showed splendid gains, which continued after the therapy was stopped, we are not able to postulate conclusions from so short a series.

It seems wiser to conclude that insulin is not indicated as a routine procedure in the treatment of bone and joint tuberculosis. For patients who are finicky eaters and who, under the best of environmental conditions, do not gain, or who actually lose in weight, insulin injections should be tried. The results shown in Figure 5 may encourage the expectation

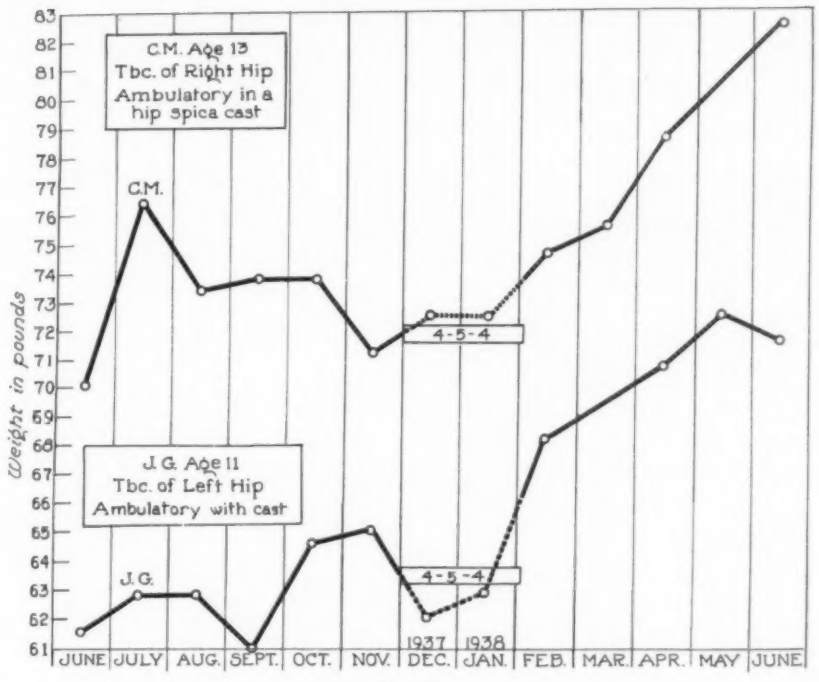

FIG. 5

Two of the older patients with tuberculosis of the hip, aged eleven and thirteen years. These patients constitute the best evidence that we have to offer of some possible value of insulin as an adjunct in the treatment of bone and joint tuberculosis.

For a period varying between six months and a year, neither patient had made a satisfactory gain in weight, and, in the case of C.M., there had been a progressive weight loss for five months preceding the beginning of insulin therapy. Immediately after the administration of 4–5–4 units of insulin daily was started, this patient again became interested in his food, frequently asking for "seconds", and there was a steady weight increment. This improvement continued after the insulin therapy was stopped.

Improvement in the case of J.G. was almost as satisfactory. It would seem justifiable to conclude that the stimulus of appetite, the improved utilization of food eaten, and the immediate and continued weight gain for these two patients was brought about by the insulin therapy.

of an appetite response and an increase in weight attendant upon an improved intake, digestion, and utilization of food.

CONCLUSIONS

1. The use of small doses of insulin, administered before meals, for malnourished patients with bone and joint tuberculosis was followed by improved appetite and moderate weight gains.

2. Patients whose weight had previously remained stationary, or who had been losing weight, continued to gain after the insulin injections were discontinued.

3. The weight gains which may accompany insulin administration would seem to be the result of improved appetite, absorption, and assimi-

lation of the normal diet of patients whose nutrition and general physical condition had been rendered subnormal by the chronic tuberculous infection of the bones and joints.

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PSEUDOFRACTURE OF THE TIBIA *

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For several years, at first independently and later together, we have been interested in certain cases which have shown a rather unusual type of lesion in the upper third of the tibia. The patients have all been children. The majority of these lesions have been treated as fractures, and yet they have all showed certain characteristics which are very unlike the ordinary results of trauma. A careful study of these cases, twelve in number, has disclosed features, quite constant in occurrence, which make us believe that the condition is a definite clinical entity, which, so far as we have been able to discover, has been noticed but has never been fully described. Several cases have been reported to us by other surgeons, who have kindly given us permission to include them in our series. The similarity between the cases has been so striking that it has not been difficult to determine the clinical aspects of the disease. Because most of these cases have been considered fractures (erroneously we believe), we have given the name of "pseudofracture of the tibia" to this condition. Further study of the disease may suggest a more accurately descriptive name.

CLINICAL FEATURES

Age and Sex Incidence

This condition occurs in children of from four to sixteen years of age. The ages of the patients in this series of cases averaged ten years and nine months. Ten of the children were boys and two were girls. One girl had a bilateral lesion, and the other girl was the youngest of the group.

Location of the Disease

In all of the cases the condition involved the same area,—namely, the upper third of the tibial shaft a few inches below the epiphyseal cartilaginous plate.

History

In all cases the patients complained of slight to moderate pain at the site of the lesion. This was accompanied by a slight limp. With the exception of one case, there was no history of trauma that could be considered significant. Three of the patients had evidence of a recent infection elsewhere in the body,—a septic sore throat, a furuncle, and osteomyelitis.

Physical Examination

In all of the cases there was local tenderness on one side or on both

* Read at the Annual Meeting of the American Academy of Orthopaedic Surgeons, Memphis, Tennessee, January 18, 1939.

FIG. 3

Pseudofracture line distinctly shown. Irregularity on antero-medial aspect of bone is due to biopsy two weeks previously.

FIG. 2

Pseudofracture line just beginning to appear.

FIG. 1

Early changes in the subperiosteal region before the pseudofracture line appears.

sides of the tibial crest, but never over the crest itself or over the tibial tubercle. Some patients showed local oedema, slight redness, and increased skin temperature, suggestive of a chronic rather than an acute condition. In two cases there was palpable periosteal thickening.

Clinical Pathology

Laboratory studies were done in only a few cases, as most of the patients were not admitted to the hospital except for care in the Out-Patient Department. One patient ran a slight temperature, ranging from normal to 100 degrees. The others had a normal temperature at all times. One patient had a white count ranging from 16,000 to 19,000, with 70 per cent. polymorphonuclear leukocytes; another showed 11,000 white cells and 60 per cent. polymorphonuclear leukocytes; and a third patient had a normal white count and differential blood analysis. Two tuberculin tests were done, and were negative. Two Wassermann tests were negative.

Roentgenographic Examination

The roentgenographic findings were those that one would expect in a low-grade infection, and their character depended on when the examination was made. If the patient was seen early (Fig. 1), there was just a

FIG. 4

Late stage of the disease. Pseudofracture line is filling in, but is still visible.

FIG. 5

End result after two years. In this case (Case 1) a biopsy was performed; otherwise the cortex would be entirely normal.

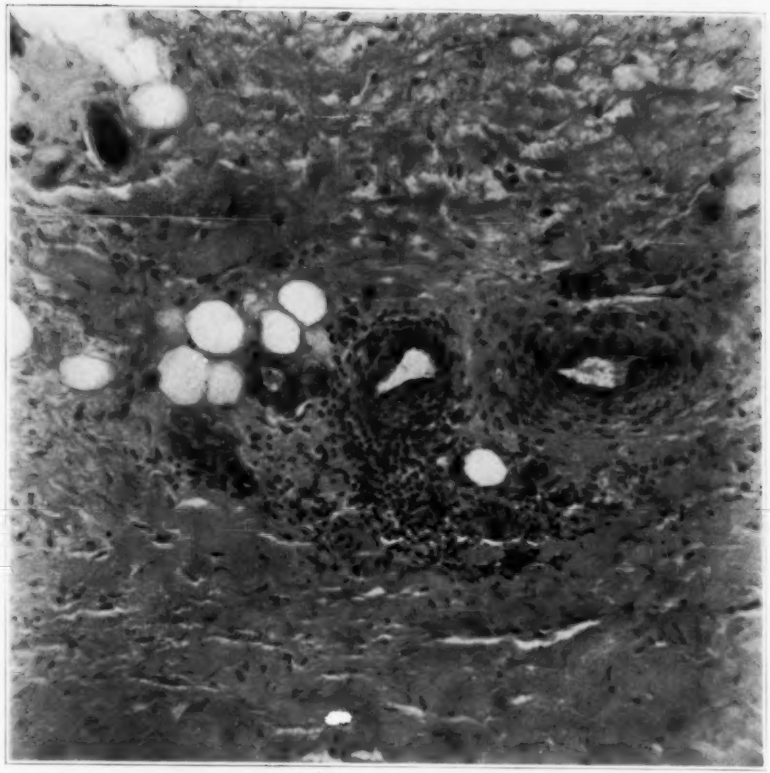

FIG. 6

Microscopic section of Case 12. Note perivascular infiltration suggesting chronic inflammation.

FIG. 7

Microscopic section of Case 1, showing sequestration and round-cell infiltration. Pathological report was chronic inflammation.

slight periosteal thickening on the posterior aspect of the tibia, hardly discernible in the films. In the course of a few weeks' time, this periosteal thickening became more evident. Beneath the periosteal new bone, one began to see what looked like a break in the cortex, closely resembling an incomplete fracture line (Fig. 2). Subsequent films showed this line becoming more distinct (Fig. 3), and it often extended transversely in an irregular manner to involve most of the diameter of the shaft.

In all of the cases that we have seen, the line of diminished density followed a fairly characteristic pattern, being somewhat V-shaped near the posterior cortex. The line was broader than a simple, incomplete fracture. It did not extend through the entire shaft, and the amount of subperiosteal new bone was greater than is usually seen in an incomplete fracture (Fig. 4). All the lesions healed without any bone abnormality (Fig. 5).

FIG. 8

Pathological fracture (Case 7) through an area of pseudofracture. Note the large amount of superiosteal new-bone formation, although the true fracture is only a few days old.

Pathology

In three cases an exploratory operation and biopsy were done. Two of them showed fibrosis and cellular infiltration typical of chronic inflammation (Figs. 6 and 7). The third case showed similar changes, but less marked, so that a definite diagnosis of chronic inflammation could not be made. All cases showed areas of typical bone regeneration and repair.

Treatment

All of the patients improved under rest and eventually became symptom-free. In those cases that were considered fractures, the patients had plaster immobilization; the others were given rest in bed, followed by limited weight-bearing. In one case the condition recurred five months after the original onset, but yielded to the same conservative treatment as before. One patient (Case 7) suffered a true spontaneous fracture while skating several weeks after onset of symptoms (Fig. 8). Because of this, we believe that plaster immobilization for a period of four weeks is the safest method of treatment.

FIG. 9-A

True fracture of the tibia in the same location and in the same age group as patients with pseudofracture.

FIG. 9-B

Two months after true fracture. Note the absence of subperiosteal new bone, which is so marked in pseudofracture. This is one of the distinguishing points between the two conditions.

DIFFERENTIAL DIAGNOSIS

Five of these cases were treated as fractures, and in all of them a diagnosis of fracture was considered. We believe, however, that this condition does not represent a fracture. The arguments against fracture are as follows:

1. With the exception of one case (Case 5), there was no history of trauma adequate to cause a fracture of the tibia.

2. Transverse incomplete fracture of the upper end of the tibia must be extremely rare in this age group, as no such case could be found in the records of the Fracture Service of the Massachusetts General Hospital during the years 1920 to 1937, and only one case was observed at the Children's Hospital.

3. Roentgenograms taken within a few days of the onset of symptoms did not show any line suggestive of a fracture. It was only after a period of from two to four, or even more, weeks that the roentgenographic appearance began to suggest a fracture line.

4. The amount of subperiosteal new-bone formation was greatly in excess of that which would follow even a more severe fracture (Figs. 9-A and 9-B).

5. Three patients had evidence of a recent infection elsewhere in the body. While this does not prove an etiological factor, it is at least suggestive.

6. In one case (Case 2), the condition was bilateral.

7. In one case (Case 2), there was a recurrence of the disease five months after the original attack had been apparently cured.

CONCLUSIONS

Pseudofracture of the tibia is a clinical entity involving the upper third of the tibial shaft in children between the ages of four and sixteen. At one stage of the disease the roentgenographic appearance may simulate a fracture, but acute trauma, nevertheless, is not an etiological factor.

The exact nature of the disease is not known. There is a possibility that it may be due to a chronic infectious process. The pathological reports on two of the cases in which biopsies were done suggested this, as did the slight fever and leukocytosis present in three of the cases. Ollonqvist, in Finland, has reported a series of cases which simulate this condition. His cases, however, occurred in young army recruits, and in each case the lesion was in the middle third of the tibia instead of in the upper third. March foot is another condition that gives a similar roentgenographic appearance except for the location. The etiology of this latter condition, as well as that of the disease described by Ollonqvist, remains unknown. Other authors have commented on what were probably lesions akin to pseudofracture. Several German writers speak of an "*Umbauzone*" and note its occurrence in other bones besides the tibia. Reischauer calls them "wear-and-tear" fractures, due to active use of the

limb, particularly in soldiers. We hope that study of the circulation in growing children may give some clue, as the roentgenograms suggest that the pseudofracture line may be influenced by the course of a nutrient artery.

CASE REPORTS

CASE 1. L. R., male, aged eleven years.

July 1931: Slight pain and limp, without preceding illness or injury, were noted.

September 1931: The patient bumped his leg, and the symptoms increased.

October 1931: The symptoms persisted, and the patient entered the hospital. Physical examination showed tenderness, slight swelling of the soft tissues, and palpable periosteal thickening.

Roentgenographic examination revealed marked periosteal proliferation and a linear area of diminished density running halfway into the shaft.

Diagnosis lay between fracture, osteomyelitis, and tumor. Because of the last possibility, a biopsy was done. At the time of operation the gross appearance of the bone was that of a healing fracture. A plaster cast was applied for four weeks. The microscopic report some weeks later was chronic inflammation.

Comment: In spite of the gross appearance of the bone, the history of symptoms was much too long and the periosteal proliferation was much too great to make a diagnosis of fracture tenable.

CASE 2. B. M., female, aged six and one-half years.

December 1933: A streptococcus sore throat developed, which kept the patient in bed for three months.

April 1934: The patient entered the hospital because of pain in the right leg, which came on as soon as she got out of bed after her illness. (She had also experienced pain in the left leg at the same time, but there were no symptoms when she came to the hospital.)

Physical examination showed tenderness without either swelling, redness, or heat.

Roentgenograms revealed fusiform subperiosteal new bone on the right, and on the left, a similar area, nearer the joint, but apparently older.

No treatment was given except that activity was restricted.

May 1934: Roentgenograms showed an irregular line suggestive of fracture on the right, and no change on the left.

August 1934: Roentgenograms showed both legs to be normal. The patient had no symptoms.

September 1934: Five months after the first entry, the patient complained of pain in the left leg, similar to that which she originally had had for a short time.

Roentgenograms disclosed periosteal new-bone formation at an area slightly lower than before and at exactly the same level as it had occurred on the right side.

December 1934: The recurrent lesion had healed, and there were no symptoms.

Comment: The facts that the condition was bilateral and that it recurred on one side are sufficient proof that the lesions were not the result of fracture. The history of severe infection preceding the symptoms is suggestive.

CASE 3. J. G., male, aged eleven and three-quarters years.

December 1933: The patient entered the hospital because of pain and limping of one week's duration. He had been kicked on the shin two weeks previously, without symptoms. A recent furuncle on the neck had just healed.

Physical examination showed slight heat, redness, and oedema. The temperature

was 100 degrees. There was slight elevation of the white count (16,000 to 19,000), with 70 per cent. polymorphonuclear leukocytes.

Roentgenograms revealed very slight periosteal thickening. No diagnosis was made.

January 1934: Two weeks after entry, roentgenograms showed marked increase in periosteal new bone and a faint line of decreased density.

January 1934: One month after entry, roentgenograms disclosed a distinct line of decreased density. A diagnosis of fracture was made, and a plaster cast was applied and maintained for four weeks.

December 1934: The patient was symptom-free.

Comment: The recent furuncle, slight temperature, and elevated blood count suggested an infectious origin. The history of trauma was insignificant. Roentgenograms did not show changes suggestive of fracture for several weeks. In spite of these facts, a diagnosis of fracture was made.

CASE 4. A. S., male, aged eight and one-half years.

December 1934: The patient entered the hospital with osteomyelitis of the third lumbar vertebra. Incision and drainage were performed.

June 1936: The patient again entered the hospital because of pain in the leg following a fall two days before. The osteomyelitis was apparently healed at this time.

Roentgenograms showed considerable subperiosteal new-bone formation and an irregular line of diminished density. The lesion was diagnosed and treated as a fracture.

June 1937: The patient was symptom-free. Roentgenograms showed a slight persistence of cortical thickening.

Comment: The changes seen in the roentgenograms could not possibly have occurred in the two days intervening between the fall and the patient's entry into the hospital.

CASE 5. J. S., male, aged fifteen years.

December 25, 1935: Following a bump on the leg, the patient had sufficient symptoms to call his family physician. He was symptom-free in a few days.

January 16, 1936: After his return to boarding school, he began to limp and to have pain in the leg again.

Physical examination showed slight heat, redness, and tenderness.

Roentgenograms revealed considerable periosteal thickening. A diagnosis of osteomyelitis was made, and the patient was sent home.

A week later, roentgenograms, taken at his home in another city, showed an irregular line of decreased density, suggesting a fracture, and the case was treated as such and plaster was applied.

July 1936: The patient was symptom-free.

Comment: This is the only case in the series in which there was trauma worthy of consideration. Roentgenograms at his home were taken just as the pseudofracture began to appear. Comparison with the previous plates would have shown the true nature of the condition. (This case is included through the courtesy of Dr. T. Lanman, Boston.)

CASE 6. J. L., male, aged nine and one-half years.

December 1935: The patient entered the hospital because of pain and swelling in the leg of three weeks' duration. There was no history either of illness or of injury.

Roentgenograms showed periosteal new-bone formation with a typical line of diminished density. The case was diagnosed as a fracture, and plaster was applied.

March 1936: The patient was symptom-free.

Comment: This was a typical case of pseudofracture, the first roentgenogram being taken when the false fracture line was visible. The error in diagnosis was more excusable than in some of the other cases.

CASE 7. A. P., male, aged fifteen years.

November 1936: There was gradual onset of pain just below the knee. No history of injury could be obtained, and the patient had no symptoms when at rest.

December 11, 1936: Roentgenograms showed periosteal proliferation, suggestive of chronic infection. No treatment was given.

December 26, 1936: The leg gave way while skating. The patient did not hit or trip on anything. Roentgenograms showed a fracture, with moderate displacement of the fragments. A plaster cast was applied, and the patient made an uneventful recovery.

Comment: At the time of the true fracture, roentgenographic examination revealed marked subperiosteal new-bone formation. The fracture was undoubtedly a pathological one, superimposed on a pseudofracture. Because of the possibility of this occurrence, treatment of pseudofractures by means of fixation in plaster for four weeks is advisable. (This case is included through the courtesy of the New England Sanitarium, Melrose, Massachusetts.)

CASE 8. F. S. male, aged thirteen years.

May 2, 1937: The patient complained of pain and limping of from three to four weeks' duration. There was no history of injury.

Physical examination showed slight swelling and tenderness. The white count was slightly elevated (11,000), with 60 per cent. polymorphonuclear leukocytes.

Roentgenograms revealed slight irregularity in the periosteum. No treatment was given except the limitation of activity.

May 26, 1937: Roentgenograms showed considerable subperiosteal new bone and an irregular line of decreased density.

March 1939: The patient has been symptom-free for two years.

Comment: In this typical case of pseudofracture, it would have been safer to have immobilized the leg in plaster. (See Case 7.)

CASE 9. E. D., male, aged ten years.

March 11, 1937: The patient complained of pain and limping of three weeks' duration. A week prior to that he had fallen, without symptoms.

Roentgenograms showed slight subperiosteal new-bone formation. The patient continued at school, but his other activities were restricted.

April 5, 1937: There was no change in symptoms. Roentgenograms disclosed a very distinct irregular line of decreased density. A diagnosis of fracture was made, and a plaster cast was applied.

June 1937: There were no symptoms except a little stiffness on running.

Comment: A diagnosis of fracture would not have been made, if the history and the changes shown in the roentgenograms had been reviewed. This was a typical case of pseudofracture.

CASE 10. E. Mc. C., female, aged four years.

November 1937: The patient had scarlet fever, and when she first got out of bed, she limped for about a week.

July 1938: The pain and the limp returned.

August 1938: The patient entered the hospital because of persisting symptoms.

Roentgenograms showed subperiosteal new-bone formation on the right. There was a questionable thickness of the periosteum of the left tibia.

August 8, 1938: Biopsy was performed. The pathological report was chronic inflammation.

September 9, 1938: Roentgenograms showed a distinct pseudofracture line for the first time. This was quite typical in spite of the biopsy findings.

December 1938: There were no symptoms. Roentgenograms showed complete healing.

Comment: This case was thoroughly studied, and all laboratory tests were found negative. It is interesting to speculate whether this was a bilateral case similar to Case 2. The history and the roentgenograms were suggestive, but not conclusive. (This case is included through the courtesy of the Hospital for the Ruptured and Crippled, New York, N. Y.)

CASE 11. R. C., male, aged ten and one-half years.

October 1937 to March 1938: The patient was confined to bed with chorea.

May 10, 1938: He began to complain of pain in his leg and to limp slightly.

May 26, 1938: Physical examination showed slight tenderness and thickening. The temperature and the blood count were normal.

July 1938: Roentgenograms showed marked periosteal proliferation with a very distinct line of diminished density.

Comment: This was a typical case of pseudofracture. (This case is included through the courtesy of Dr. E. C. Janes, Hamilton, Ontario.)

CASE 12. R. S., male, aged sixteen years.

July 16, 1938: The patient entered the hospital complaining of pain and limping on the left side. There was no history of injury.

Roentgenograms showed marked subperiosteal new-bone formation and a line of diminished density on the left. On the right, there was thickening of the bony cortex posteriorly at the level of the lesions described by Ollonqvist.

Biopsy was performed on the left leg, and a pathological report of chronic inflammation was returned.

Comment: The lesion on the left was a little lower than those in the younger patients of this group. The questionable lesion on the right was just above the mid-shaft, suggesting that pseudofracture and the condition described by Ollonqvist may be the same disease occurring in different age groups. (This case is included through the courtesy of Dr. Alexander P. Aitken, Boston, Massachusetts.)

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TREATMENT OF UNUNITED FRACTURES OF THE CARPAL NAVICULAR

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Next to fractures involving the lower end of the radius, the most common bone injury encountered at the wrist is fracture of the carpal navicular. It is frequently met with in accident cases in the Witwatersrand gold mines. Not only is this one of the commonest carpal injuries, but, from the disability standpoint, it is often most serious when overlooked, and the frequency with which ununited fractures of the navicular are still observed is testimony either to inadequate treatment of the fresh fracture or to the entire overlooking of the lesion by the patient or the doctor or both.

It cannot be emphasized too strongly that all wrist injuries should be subjected to roentgenographic examination. Occasionally the fracture does not show in an early roentgenogram, or, if it is visible, it may present itself as such a fine crack that it may be easily overlooked even by an expert. Therefore, roentgenographic examination should be repeated in ten days if there is reason to believe that something more serious than a sprain of the wrist has been sustained. A later roentgenogram may show, instead of the fine crack with no displacement, a considerable gap between the fragments.

Unless a wrist so affected is adequately immobilized, movement between the fragments gives rise to decalcification and a cyst-like appearance. The most adequate splint is the unpadded plaster cast, snugly applied from below the elbow to the metacarpophalangeal joints of the fingers and the interphalangeal joint of the thumb, with the wrist placed in dorsiflexion and radial abduction, and with the thumb also abducted. This approximates the radial styloid and the lesser multangular against the outer fragment of the fracture and compresses the latter against the inner fragment, which is jammed up against the capitate. The fingers are left free, so that in this position quite a degree of functional use of the hand is possible. Although Böhler suggests a six-week period of immobilization, the author's own experience leads him to feel that such a cast should be left on for ten weeks, in order to assure union.

If pain and weakness in grip persist for months or years after injury to a wrist, the cause of such symptoms will frequently be found in the existence of an ununited fracture of the navicular. In addition, there will be limitation and pain at the extremes of all movements of the wrist and tenderness in the "anatomical snuff-box" when the hand is abducted and over the radionavicular joint dorsally and the tuberosity of the navicular anteriorly. The roentgenogram frequently shows a cyst-like cavity, partially filled in, and the fracture surfaces become dense and sclerosed.

The sclerosis will never allow union between the fragments, even if immobilization is most rigid, and serious disability will follow unless union is in some way achieved. A patient with non-union of a fractured navicular, who is able to follow a sedentary occupation and to avoid strenuous use of the hand, may have little discomfort, but, if he engages in sports or has to carry out heavy labor or other work where full range of movement of the wrist is important, then the crippling effects of such non-union are extreme. Severe arthritis supervenes and becomes progressive, for, not only do the immediately neighboring intercarpal joints become involved in this arthritic process, but also the radiocarpal joint is affected, and often the patient becomes so disabled that he has to give up his occupation.

Nowhere is the factor of lack of absolute immobilization so exemplified as a cause of non-union as in the case of the carpal navicular. The bone repair in a cancellous bone such as the navicular is not as active as in the long bones and is inhibited by use and movement resulting from improper immobilization. It is markedly localized to the line of fracture, as there is little periosteum to assist in the formation of subperiosteal callus. The formation of bone in the callus is slower than in other fractures. This may be due to the notoriously poor blood supply to the bone. The navicular has only a small surface posteriorly and anteriorly for the attachment of ligaments. Elsewhere it is covered with cartilage. Its blood supply is derived from two vessels, one of which penetrates the tuberosity of the bone. A fracture through the waist of the bone renders the proximal fragment avascular. Because of the poor blood supply, union takes a long time, for the vessels have to grow from the peripheral into the central fragment. These fine capillary vessels are ruptured with the slightest shearing movement; hence the necessity for complete immobilization. With adequate and early immobilization no case of non-union should ever be seen.

In the past, excision of one fragment, of both fragments, or of all the bones of the proximal row of the carpus, including the navicular, has been advocated to deal with disability resulting from non-union of a fractured navicular. Such procedures, however, are to be condemned, for they leave a deformed wrist, with more or less permanent disability in the form of impaired function, frequently accompanied by pain on active use of the hand. Böhler strongly disapproves of the removal of the navicular for non-union and quotes Kemper, who reported a series of sixty cases in which removal of the navicular resulted in poor function of the hand. It is true that in cases of very long standing, with serious arthritic changes already present, it may be justifiable to excise the proximal row of carpal bones in order to improve function. However, from the author's experience, even this drastic procedure does not always help much.

Another method of treatment which is in vogue is that of bone-grafting with an autogenous tibial graft perforating the two fragments, as advocated by Murray. However, it is the author's belief that osteogenetic reaction can be obtained without a graft and without the infliction of

the considerable trauma incidental to the insertion of such a graft. In Murray's cases the lesions had existed for two months, four months, four weeks, six months, and four months respectively. In cases of very long duration *without* arthritic changes, such an operation might be of value, although it is interesting to note that Kellogg Speed reports a case of two years' duration in which bony union was achieved by drilling. The writer's experience agrees with that of Speed, and he feels that the simpler procedure of bone drilling is the method of choice.

The rationale of the bone-drilling operation is that the sclerosis is broken up by drilling across the fracture surfaces, which allows revascularization of these surfaces and of the intervening fibrous tissue, as the capillaries find their way through the drill holes from one fragment into the other. Böhler drills the navicular under local anaesthesia by a more or less subcutaneous method wherein he inserts a small drill into the "anatomical snuff-box" through both fragments under a roentgen-ray screen to check the position. The author has found this procedure difficult, uncertain, and requiring special facilities as to asepsis, etc., which are not always available in a roentgenological department. Personally, the writer finds an open operation exceedingly simple, and nothing is left to chance. The navicular is exposed by a dorsal incision to the radial side of the extensor pollicis longus. After the tendon of this muscle has been retracted, the radionavicular capsule is incised, and the proximal fragment is easily reached. The fracture line is left undisturbed, and a *small* drill of the reciprocating type is made to penetrate from one fragment into the other five or six times in different planes. After wound closure, immobilization is carried out in a plaster-of-Paris cast with the wrist in 45 degrees of

FIG. 1

Case 1. A. P. Ununited fracture of right carpal navicular of nine months' duration. Before operation.

FIG. 2

Case 1. A. P. After bone-drilling operation.

dorsiflexion and in radial abduction exactly as if one were dealing with a recent fracture. After eight weeks a roentgenogram is taken, and, if some union is evident, another plaster cast is applied for an additional four or five weeks. Postoperative immobilization must be prolonged, and this is of the greatest importance.

In the following six cases, in which the operation was performed at periods ranging from three months to nine and one-half months after injury, bony union resulted.

CASE REPORTS

CASE 1. A. P., male, aged twenty-two, a blacksmith, had sustained an injury to the right wrist while at work in October 1934. He had continued to work, although the wrist was very swollen and painful. The swelling had gradually diminished, but the pain had persisted. The first roentgenographic examination, *made a month after the accident*, revealed a fracture of the navicular. The patient was then treated by massage for several months with no effect on the pain in the wrist. When seen by the author on June 22, 1935, he complained of pain at the back and side of the wrist, of weakness in the grip of the hand, and of occasional shooting pain passing up the forearm. The usual signs of an ununited fracture of the navicular were demonstrable, and a roentgenogram (Fig. 1), taken ten days previously, revealed an ununited fracture through the waist of the bone with a wide gap, traumatic cavitation, and a certain amount of sclerosis at the fracture line proximally. No arthritic changes were evident. A bone-drilling operation was advised, and this was carried out on June 26, nine months after the original injury. On October 1, when the plaster was removed, roentgenographic examination (Fig. 2) showed complete bony union, and the patient returned to work nine days later.

CASE 2. W. M., male, aged twenty-five, a machinist, had sustained a fracture of the right carpal navicular while at work in November 1935, the lesion having been demonstrated the day after the accident. The wrist was put up in an elastoplast bandage for

FIG. 3

Case 2. W. M. Ununited fracture of right carpal navicular. Before operation.

FIG. 4

Case 2. W. M. After bone-drilling operation performed four months after injury.

FIG. 5

Case 3. W. F. Ununited fracture of right carpal navicular. Before operation.

FIG. 6

Case 3. W. F. After bone-drilling operation performed nine and one-half months after injury.

ten days. At the end of this period, a plaster-of-Paris cast was substituted, and this was worn until ten days before the patient was seen by the author on January 4, 1936. He complained of pain on gripping with the wrist flexed, and the physical examination revealed the usual signs of a fractured navicular. In view of the fact that the injury was comparatively recent, it was suggested that treatment by a further period of immobilization in plaster might result in union. This was accordingly carried out, but roentgenographic examination on February 22 showed the fracture line still clearly visible and the presence of a semicircular area of rarefaction (Fig. 3). A bone-drilling operation was then advised, and this was performed on February 25, 1936, about four months after the original injury had been sustained. Roentgenographic examination on May 16 showed definite new-bone formation across the fracture at its center, although on each side of this the fracture line was still visible. Six weeks of further immobilization in plaster resulted in complete bridging of this line of fracture (Fig. 4), and the patient returned to work ten days later.

CASE 3. W. F., male, aged twenty-eight, a shift-boss, had sustained an injury while playing football in May 1935. This had been treated as a sprain until a month afterward, when roentgenographic examination revealed a fracture of the right carpal navicular. The wrist was immobilized in a Carr splint for six weeks, and the patient managed to do his work, although weakness of the wrist was present. Ten days before he was seen by the author on February 12, 1936, he had put his hand out flat in crawling while mining and had experienced a sudden severe pain in the affected wrist. This pain persisted, and the usual symptoms and signs of an ununited fracture of the navicular were present. A roentgenogram (Fig. 5), taken a few days before the patient came to the author, showed a fracture through the waist of the right navicular, the antiquity of which was substantiated by marked sclerosis of the fracture surfaces. A bone-drilling operation was performed on February 14, 1936, nine and one-half months after the accident. On May 18, 1936, roentgenographic examination showed complete bridging across the line of fracture (Fig. 6), and clinically the patient had no further trouble. This patient carried on his work during the whole period of immobilization in plaster with the exception of a period of two weeks after the operation.

CASE 4. N. B. B., male, aged twenty-one, a sampler, had sustained an injury to the left hand while boxing on August 15, 1936, but, since the injury appeared to be only a

FIG. 7

Case 6. C. D. N. Ununited fracture of right carpal navicular. Before operation.

FIG. 8

Case 6. C. D. N. After bone-drilling operation performed four months after injury.

slight sprain, he disregarded it. Although a certain amount of weakness and discomfort had persisted, he continued with his work until October 31, when he sustained a fall on the outstretched left hand. Since that time the wrist had been very painful and weak. Roentgenographic examination on November 2, when he consulted the author, showed a fracture through the waist of the left navicular, with considerable decalcification on both sides of the fracture line. This was inconsistent with his having sustained the fracture at the more recent of the two accidents, and, from the compensation point of view, it was important to be able to establish the fact that the fracture was of long standing and not related to injury sustained while at work. A bone-drilling operation was performed on November 13, three months after the accident. Roentgenographic examination on February 5, 1937, showed commencing union, and, after a month's further immobilization, the roentgenogram showed satisfactory trabeculation across the line of fracture. The patient returned to work a few days later without disability.

CASE 5. J. P. S., male, aged twenty-seven, a miner, had sustained an injury to the right wrist on September 30, 1936. Roentgenographic examination by his doctor on the day after the accident revealed a fractured navicular, and the wrist was put into a plaster-of-Paris cast for two weeks only. The wrist was then given massage for two weeks. When seen by the author on December 14, the patient complained of constant pain in the wrist and thumb and of an inability to flex and to extend the hand properly. The usual signs of an ununited fracture were present. Roentgenographic examination on December 9 showed a fracture through the waist of the right navicular with a cyst-like appearance of the bone in relation to the fracture. Some comminution of the bone was evident. A bone-drilling operation was performed on January 19, three months and three weeks after the original accident. On April 26, a roentgenogram showed complete bony union of the fragments. The patient returned to work soon after this date. No disability was complained of when the patient was seen by the writer three months after the last roentgenogram was taken.

CASE 6. C. D. N., male, aged thirty, a reduction worker, had sustained an injury to the right wrist while at work on March 8, 1938. He had disregarded the injury and had continued to work. He had consulted his doctor a week after the accident, and treatment

was prescribed. Because of persistence of the pain, the wrist was x-rayed on May 27. When seen by the author on June 20, the patient complained of pain and weakness in the wrist and of inability to use the hand properly at work. The usual signs of ununited fracture of the navicular were present. The roentgenogram taken on May 27 (Fig. 7) showed an ununited fracture of the navicular with a well-marked circular cyst-like area in the bone. A bone-drilling operation was advised, and, after some hesitation on the part of the patient, this was carried out on July 2, practically four months after the date of the original injury. Roentgenographic examination on September 30 showed complete consolidation of the cyst-like area, the drill holes being still clearly visible (Fig. 8). The patient returned to work two weeks after the last roentgenographic examination, and the wrist has remained symptomless since that time.

CONCLUSIONS

1. Fractures of the carpal navicular are commonly met with. If they are overlooked or are inadequately treated, as is frequently the case, non-union occurs.

2. Cases of established non-union can be dealt with adequately by drilling multiple holes across the line of fracture by open operation; good bony union is promoted by such an operation, provided subsequent immobilization is prolonged.

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THE RECURRENCE OF FLEXION AND ADDUCTION DEFORMITIES FOLLOWING OPERATIVE FUSION OF THE HIP AND SUBTROCHANTERIC OSTEOTOMY *

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It has been frequently observed that in a very large percentage of the cases correction of the position of the femur following operative fusion of the hip or subtrochanteric osteotomy is not maintained. Patients presenting an ankylosed hip with a marked flexion-adduction deformity too frequently give a history of having had an earlier successful operative fusion. It is, therefore, evident that this sequela is not generally recognized by most surgeons. This can best be explained by the fact that the deformity is necessarily slow in developing, and, unless the patient is observed over a prolonged period of time, the final result may always remain unknown. It is the purpose of this paper to point out some of the causes of the apparent failure of the corrective measures.

The clinical material for this study was obtained from cases which had been treated and adequately followed at the Massachusetts General Hospital, Boston. The cases were divided into two groups.

Group A included those cases in which there had been a successful operative fusion of the hip joint. In this group the author was primarily concerned with whether or not a hip successfully ankylosed would maintain its corrected position, and, if not, when the correction was most likely to be lost and what were the contributing factors. No case was included in which there was any doubt as to the presence of a bony ankylosis within a reasonable time following operation. All cases with persistent postoperative infection and sinus formation were likewise excluded. For these reasons, out of sixty-five cases reviewed only twenty-three were found suitable for study. Chronic tuberculosis was the most common indication for fusion, but, for the sake of brevity, an etiological classification has been omitted. The ages varied from eight to fifty-seven years; the average age was nineteen years, although over one-half of the patients were under fifteen years. The postoperative follow-up period varied from three to twelve years; the average was over five years. In three of the cases followed for the shorter period a flexion-adduction deformity developed, which required a corrective osteotomy; therefore, these cases were subsequently followed in Group B.

Group B included those cases in which a flexion-adduction deformity had developed or presented and was corrected by subtrochanteric osteotomy. No case was included in which at the time of operation a solid bony ankylosis of the hip was not present. Twelve cases were found suitable for study. In two of these two osteotomies were required before the

* Read before the Western Orthopaedic Association, San Francisco Chapter, on March 8, 1938.

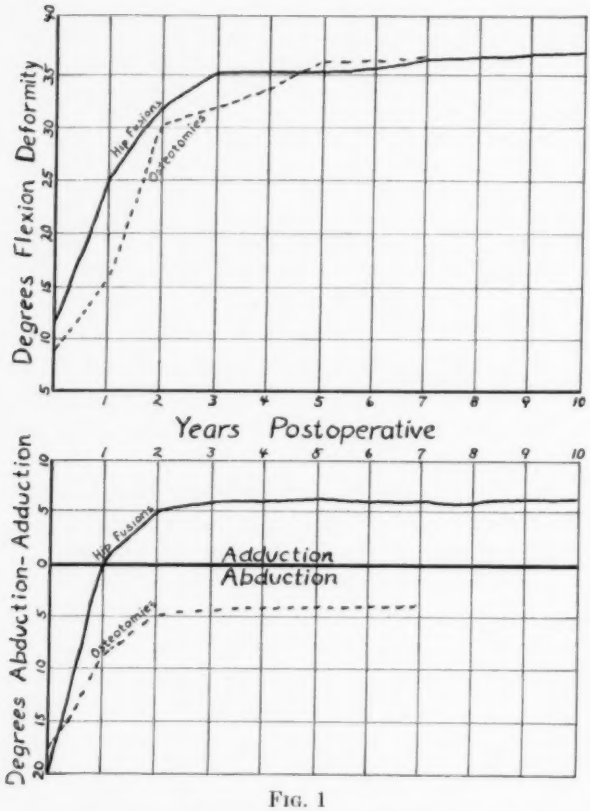

FIG. 1

Showing the rate and extent to which the loss of postoperative correction occurred in both groups.

desired correction was maintained, and in one an adductor tenotomy was performed. The ages varied from nine to twenty-four years, the average being sixteen years. The postoperative follow-up period ranged from three to ten years, the average being four and one-half years.

In both groups, when possible, the position of the femur in relation to the pelvis was determined by means of a goniometer and checked roentgenographically, but often previous clinical estimates had to be relied upon and are necessarily subject to a reasonable degree of error. This is especially true of the data obtained from the recorded positions estimated at the time of operation.

The results of this study are graphically illustrated in Figure 1, in which the degree of developing deformity has been plotted against time. There was considerable variation from the composite average in each group, depending upon various factors, but, for the sake of clarity, no attempt has been made to illustrate this on the graph. As a rule, the findings were sufficiently constant to allow the drawing of several general conclusions.

In Group A—the cases in which operative fusion of the hip joint had been done—it was observed that in no case was the original operative correction completely maintained. Whatever deformity developed did so within the first three years following operation, and there was very little change thereafter. Thirty-seven degrees was the average maximum flexion that developed and 6 degrees was the average maximum adduction. Since this is approximately the normal adduction of the femur in relation to the pelvis, it may be considered a neutral position. In almost all of the cases a very definite flexion deformity developed. The postoperative position of abduction was quickly lost, in most cases during the

plaster-fixation period; the extremity then gradually swung into slight adduction. Patients without marked deformity, but with a fibrous ankylosis resulting from joint infection, responded most favorably to the fusion procedure. In general, the adduction deformity was not apt to occur if bony ankylosis was obtained in a relatively short time after operation; this, however, was not true in regard to the flexion deformity, which seemed to increase even after bony union.

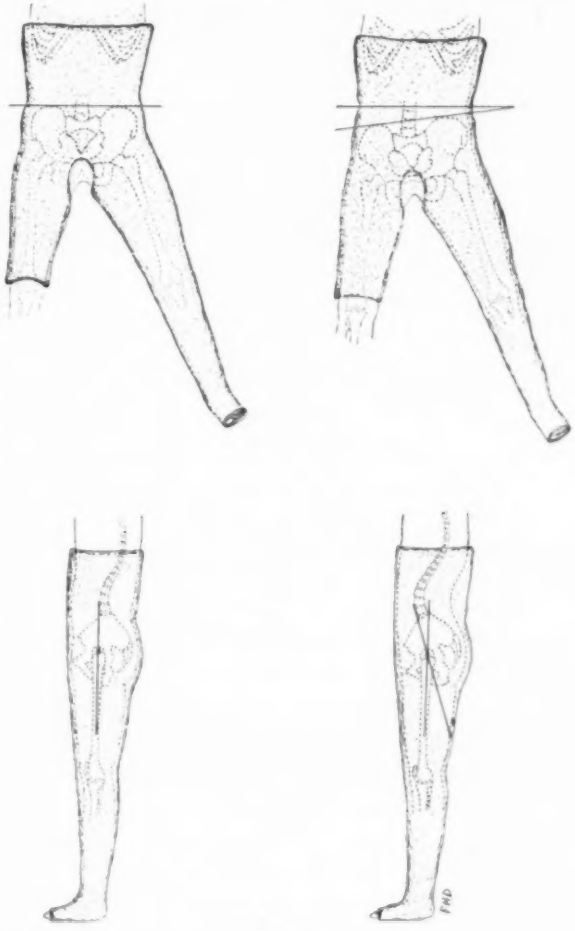

FIG. 2

Showing how the pelvis may tilt within a double hip spica.

In Group B—the cases in which a corrective osteotomy had been performed—it was also found that in no case was the operative correction completely maintained. Here again, the greatest loss of abduction occurred during the plaster-fixation period before firm union had occurred, with no further change after approximately two years. This was not true of the flexion deformity, which continued to progress until it had reached approximately the same degree as in Group A.

The rapid and persistent recurrence of these deformities, despite bony union, calls for a consideration of the factors involved. It must be remembered that the average hip treated by arthrodesis or subtrochanteric osteotomy is a diseased hip, and, even though the disease may be quiescent, the healing process has resulted in the production of considerable scar tissue, which has a tendency to contract. The change in the position of the head, necessitated by the correction, not only places this tissue under considerable tension, but usually tears it, with the resultant production of more scar tissue and its subsequent contraction. It seems only natural

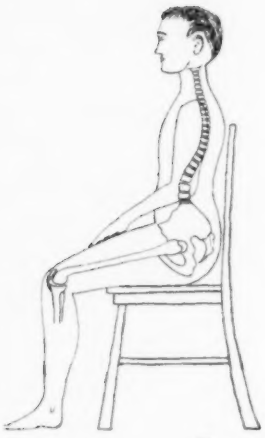

FIG. 3-A

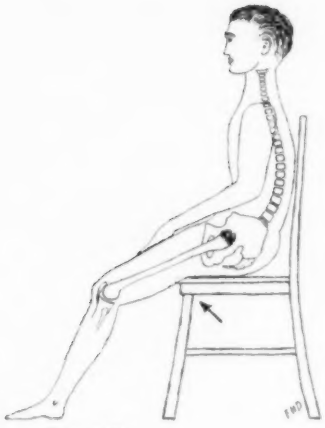

FIG. 3-B

Fig. 3-A: Sitting with normal hip flexion.

Fig. 3-B: Sitting with the hip ankylosed in extension, illustrating the extreme degree to which the pelvis must tilt and the lumbar spine must flex in order to compensate for the lack of hip flexion. Note how the weight-bearing is transferred from the ischial tuberosities to the sacrum, with a tendency toward an upward thrust on the thigh.

then that, unless prolonged and accurate postoperative fixation is maintained, some recurrence due to this factor alone should be expected.

From a study of the two groups, it is evident that too little consideration is being given to the fixation period. It is the author's opinion that the average hip spica, as it is commonly applied, does not prevent the pelvis from rotating within the plaster (Fig. 2). In Group A, in spite of plaster fixation ranging from four months to two years, the deformity recurred. Unless the pelvis is securely fixed, there is little to prevent the gradual pull of the adductors and flexors of the thigh—which are usually under considerable tension, especially if they are shortened from adaptation to a previously flexed and adducted position—from gradually tilting the pelvis toward the femur, thus diminishing the correction. The double hip spica, with the opposite hip in a position of wide abduction, minimizes this tendency. During the early changes of plaster, when muscle spasm is still present and union is incomplete, particular care should be taken that loss of correction does not occur. Adequate fixation must be maintained until there is solid bony ankylosis. Tenotomy of the adductors should be performed when they are too resistant to allow adequate abduction. This should not be a routine procedure, however, since they are a

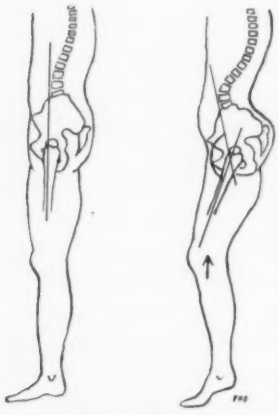

FIG. 4-A FIG. 4-B

Fig. 4-A: Weight-bearing by straight-line thrust through a normal hip.

Fig. 4-B: Weight-bearing on a hip with an obtuse angle of flexion deformity.

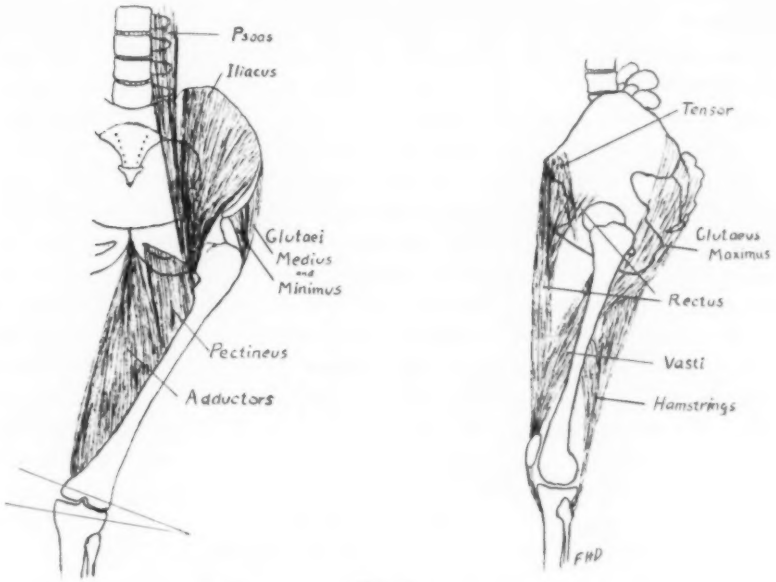

FIG. 5

Note the apparent mechanical advantage of the adductors. This is not so evident in the flexor group.

distinct aid in keeping the head of the femur firmly in the acetabulum. In the one case in Group B in which an adductor tenotomy was performed, 10 degrees of abduction was maintained, which was more than the average for this series.

Although inadequate plaster fixation may play a part in the recurrence of the flexion deformity, this does not seem to be the only factor. In all of the cases in Group B the plaster spicas were removed before the end of the first year after operation, yet the flexion deformity continued to progress. This can be explained partially by the fact that the patient sits more frequently than he stands or walks. It is quite difficult for most patients to sit comfortably with the hip ankylosed in less than 30 degrees of flexion (Figs. 3-A and 3-B). In the sitting position, there is a constant tendency for the femur to be pushed upward into a more flexed position. It is easy to see that sitting in bed would tend to have the same effect. The vicious leverage of the sitting position is especially effective in cases of fibrous or incomplete bony ankylosis. When the flexion reaches 35 to 40 degrees, the constantly deforming leverage has been sufficiently diminished and, therefore, has become ineffective, in accordance with Wolff's law.

Too early weight-bearing, with the hip in partial flexion, before firm bony union has taken place, may also be a factor in increasing the flexion deformity (Figs. 4-A and 4-B). Weight-bearing with the hip in partial flexion does not permit a straight-line thrust of the body weight through the hip joint. On the contrary, when the hip is in this position, the weight

of the body is borne on an obtuse angle and in such a way that a continued upward thrust on the femur would tend to make this angulation more acute, thus increasing the flexion deformity.

Muscle imbalance is another source of deformity to be considered. There can be very little question that the adductors have greater power than the abductors. The flexors and extensors, however, are more nearly equal in power; there is not a sufficient preponderance of power on the part of the flexors to produce flexion deformity. (See Figure 5.)

The age of the patient at the time of hip fusion seemed to be only a minor factor. In general, the tendency toward the development of a troublesome deformity was found less frequently in adults than in children. However, in this series, most of the hip fusions in adults were perormed because of painful hips, largely resulting from traumatic or degenerative arthritis of the hip joint. The operation was more likely, therefore, to be performed in an aseptic field, and a better operative result could be expected. In the younger group, this was not true. Chronic tuberculosis or old sepsis of the hip were the more common preoperative diagnoses. Thus a very large percentage of the operations performed had to be done in what at one time had been a septic field. There had also been considerable bone destruction,—the head and neck of the femur had frequently been destroyed as well as portions of the acetabulum. These factors did not facilitate the technical performance of the operation or encourage rapid union.

The presence of an actively growing femoral epiphysis was not a factor in this series. In many of the cases that fell within this age group this area had been destroyed. Extra-articular fusion was generally used in children, the fusion being performed between the greater trochanter and the ilium and thus across the epiphyseal line if it were present. Age, then, seemed to be a factor only to the extent that the indication for fusion in the adult is more likely to be for conditions which are more favorable to rapid union. It was the nature of the bone in the operative site, plus the technical skill of the operator, which governed the rate at which ankylosis took place and the ultimate success of the operation, rather than any definite age factor.

It was interesting to note that none of the patients in this series complained directly of their flexion deformity. Complaints were chiefly due to shortening, inability to sit comfortably, backache, and strained or relaxed knees. The last-mentioned disability was especially noticeable in patients with an adduction deformity resulting from ankylosis in early childhood. In view of this fact, it would seem inadvisable to operate to correct a flexion deformity alone, unless it amounted to more than 37 degrees, for in all probability it would recur or the patient would experience considerable discomfort when sitting. More attention should be given to the prevention of the development of a fixed adduction deformity, for this is much more likely to be troublesome to the patient and to give rise to symptoms.

The fact that there was practically no tendency for the deformity to progress after three years lends support to the general opinion that a progressing deformity of this type is due to a failure to obtain firm bony union. In the group of subtrochanteric osteotomies, the operation was performed in an area noted for its vascularity, abundance of callus, and rapidity of union; in these cases the correction, particularly that of adduction, was generally better maintained. Firm bony union after hip fusions is on the average a very slow process. Either more attention must be given to the fixation period or additional measures should be more frequently used to weaken the muscle groups responsible for pulling the femur into the deformed position. It is the author's opinion that this phase has been neglected and that, unless more attention is paid to it, the postoperative correction will not be maintained and hip fusions will in the future, as in the past, too frequently require subsequent corrective osteotomies.

SUMMARY

1. The corrected position of the femur following operative fusion of the hip joint is on the average not maintained. This is true to a lesser extent following subtrochanteric osteotomy.

2. The greatest loss of correction occurs during the first few months after operation, before firm union has been established.

3. Solid bony union following hip fusion is a slow process, necessitating prolonged and careful fixation if the corrected position is to be maintained. This is the most important period of the postoperative treatment, the period which decides the success of the corrective procedure.

A FUNCTIONING FALSE SHOULDER JOINT FOLLOWING AN OLD DISLOCATION

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From the Anatomical Laboratory of the Boston University School of Medicine

An unusual and interesting specimen was uncovered in the anatomical laboratory in cleaning a shoulder girdle. Unfortunately, the pathology was not discovered until the remainder of the body had been destroyed. This specimen was interesting in that, instead of the usual rigid shoulder with all abduction being obtained by scapular motion, motion was present to a surprising degree, as a new articulation had developed between the neck of the scapula and the humerus.

FIG. 1

Anterior view of scapula showing new articulation. Humerus in external rotation to show articular facets.

As shown in Figures 1 and 2, there was a subcoracoid dislocation with fracture of the anterior rim of the glenoid. A hard eburnated surface was found on the under side of the coracoid process, which was continuous with a like area on the new-bone formation that had taken place on the anterior surface of the neck of the scapula after the injury. This corresponded to similar areas on the posterior border of the head and greater tuberosity of the humerus. From the evident bone reaction, the joint capsule had been torn along nearly its entire attachment to the humerus, but with no disturbance about the glenoid except where the fracture of the rim took place. The attachment of the supraspinatus tendon was encroached upon, and there is evidence to show that the tendon assumed a new course, wearing a groove in the subcoracoid region. Likewise, the infraspinatus tendon had smoothed over an area on the posterior rim of the glenoid to reach its attachment to the

FIG. 2

Posterior view. Normal shoulder on right for comparison.

humerus. The long head of the biceps apparently had been ruptured, as the bicipital groove was nearly obliterated, except at the distal end, where a definite hole was found, which evidently had been made by callus surrounding the biceps tendon as it passed into the groove.

It was unfortunate that the pathology was not discovered previous to the dissection of the cadaver, so that the actual relationship of the soft parts might have been recorded. It would be interesting to know the past history, but, from the evidence, it seems logical that there had been good motion at the shoulder following a fracture-dislocation sustained some years before. A review of the literature did not disclose any similar cases in which such apparently good motion was present.

CORACOCLAVICULAR JOINT

BY DR. BORIVOYE GRADOYEVITCH, BELGRADE, YUGOSLAVIA

From the Clinic of Surgery, University of Belgrade*

The existence of a joint between the clavicle and the coracoid process is rare, and only fifteen cases are known to medical science. Ten have been proved anatomically and five roentgenographically. Testut recorded three cases shown by anatomical dissection, and Gruber, Lushka, Fick, Jeanneney and Celles, Gowland, Miessen, and Schlyvitch reported one each. Roentgenographic evidence of such a joint has been recorded by Frassetto (three cases), Ikeda, and Possati. In the case to be described, one of bilateral symmetrical coracoclavicular joint, the diagnosis has been made roentgenographically.

CASE REPORT

The patient is a clerk, aged forty-one years, whose parents, five brothers, and twin sister are healthy and well developed. There is no family history of congenital abnormalities. The patient has never been ill, and is a healthy subject of middle height, with powerful muscles, well-developed by rowing and other athletic activities. He has no symptoms. The shoulders are of normal outline and are symmetrical. Movements of both shoulders are easily performed in all directions without limitation. The acromioclavicular and sternoclavicular joints show no clinical evidence of abnormality. The strength of the limbs is normal.

Roentgenograms show a bony outgrowth from each clavicle at the site of attachment of the conoid and trapezoid ligaments; this outgrowth is triangular in shape with the base

FIG. 1

* Chief Surgeon: Prof. Kostitch.

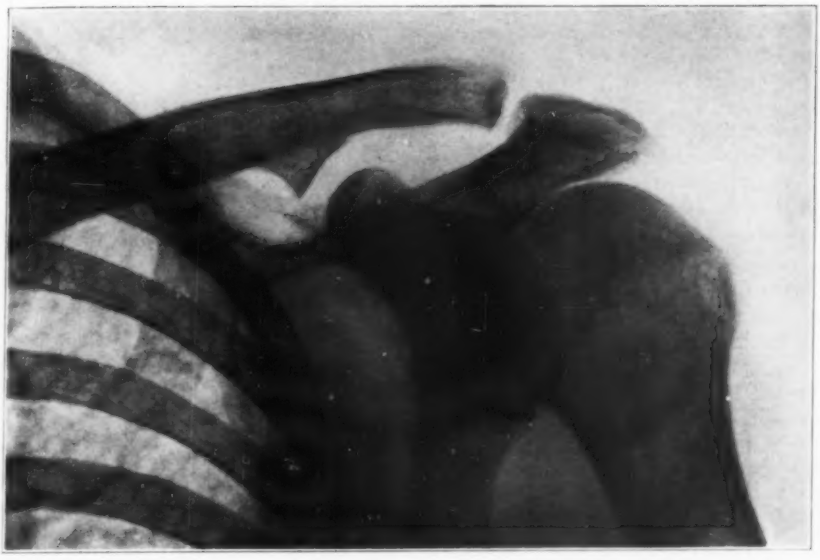

FIG. 2

at the clavicle and the apex directed downward. The outer surface is oblique and perfectly smooth, and it is in exact apposition with the surface of the coracoid process. The interval between the bones has all of the appearances of an interarticular space (Figs. 1 and 2).

Poirier alone believes that an articulation in this position is not rare; he thinks that it exists in 30 per cent. of the cases. Schlyvitch maintains that Poirier has included all cases which show cartilage on the neighboring surfaces of the clavicle and the coracoid. Proof of the existence of a joint demands evidence of two cartilaginous articular surfaces,—a capsule and a synovial membrane. Schlyvitch has dissected sixty cadavera and in only one did he find all of the necessary elements to conclude that there was a true joint. In that case there was a diathrosis, with the articular surfaces partly covered with cartilage and joined by a true capsule with an interarticular synovial fold.

In the case now recorded, the large apophysis with a shape and surface so exactly adapted to the surface of the coracoid, forming with it an interarticular space, leads one to presume the existence of articular capsule, synovial membrane, and cartilaginous surfaces. In Schlyvitch's case there was no such well-developed boss of bone, but nevertheless all of the elements of a joint were found. We did not, however, feel justified in submitting the patient to the pain of experimental injection of contrasting substances such as uroselectan B or air, with the object of proving the existence of a joint cavity.

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TENDON TRANSPLANTATION

An End-Result Study of 458 Transplantations

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From the Shriners' Hospital for Crippled Children, Springfield, Massachusetts

Until Dr. Charles W. Peabody's end-result study of tendon transposition [1], there had been no critical review of end results of a large series of tendon transplantations in the United States.

This present paper is a review of the results of tendon transplantations done at the Shriners' Hospital for Crippled Children, Springfield, Massachusetts, during the first ten years of its existence—1925 to 1935. All of these were done either by Dr. R. Nelson Hatt or under his supervision. Eight hundred and seventy-eight tendon transplantations were performed upon 538 individuals. After going over the records, the author found that there was little change in the status of a transplantation after two years. By that time it was quite evident whether a transplantation

TABLE I
Distribution of Cases

Diagnosis	No. of Transplantations	No. of Patients
Post-Poliomyelitis	339	216
Congenital Equinovarus	74	58
Cerebral Spastic Paralysis	31	13
Severed Tendons	3	3
Miscellaneous	11	8
Total	458	298

was going to be a success or a failure. However, to be conservative, only those cases which had been followed in the Out-Patient Clinic for three years or more were included in the detailed study. This left 458 separate transplantations performed on 298 individuals, with an average follow-up period of five years. Table I shows how the cases were divided. Seventy-four per cent. of the transplantations were done in the post-poliomyelitic cases. Sixteen per cent. were done in the treatment of congenital equinovarus. The remaining 10 per cent. were divided among cases of cerebral spastic paralysis, severed tendons, progressive neuropathic peroneal muscular atrophy (Charcot-Marie-Tooth peroneal paralysis), spina bifida, flat-foot, congenital absence of the fibula, congenital dislocation of the patella, brachial birth paralysis, and arthrogryposis.

The average age of these children at the time of the transplantation

TABLE II
END RESULTS OF ALL GROUPS OF TRANSPLANTATIONS

Diagnosis	No. of Transplantations	End Results				
		Excellent (*Per Cent.*)	Good (*Per Cent.*)	Fair (*Per Cent.*)	Poor (*Per Cent.*)	Unsatisfactory (*Per Cent.*)
Post-Poliomyelitis	339	12	39	33	12	4
Congenital Equinovarus	74	36	38	19	7	0
Cerebral Spastic Paralysis	31	3	35	48	0	13
Severed Tendons	3	0	67	0	33	0
Miscellaneous	11	0	27	36	36	0
Total	458	15	38	32	11	4

was nine years and two months. Sixty-eight per cent. of the patients were boys and 32 per cent. were girls. Fifty-seven per cent. of the transplantations were on the right side and 43 per cent. on the left side. In 49 per cent. of the transplantations, stabilizing procedures were done at the same time; in 51 per cent., there was no primary stabilization.

The transplant was protected by a plaster cast for an average immobilization period of four weeks and six days. After removal of the cast, muscle training was carried out in the Hospital for a few weeks and then continued at home. The postoperative cast was worn frequently as a night splint for two additional months. Few patients had long-continued postoperative protection with braces.

Unfortunately muscle coordination was not recorded in these cases. This would be helpful in determining the outcome of a transplanted muscle. Muscle coordination varies greatly in different persons. While in one case the patient may learn quickly to use the transplanted muscle well, in another, atrophy may develop even though exercises are given regularly.

CLASSIFICATION OF RESULTS

The most difficult part of an end-result study is to classify accurately the results obtained in each case. In evaluating the results of the follow-up charts, it is hard to separate facts from the observer's enthusiasm. In this particular study, the postoperative notes were written by several members of the Hospital staff. The author has studied carefully all of the records and has examined personally many of the patients.

Each transplantation was classified as excellent, good, fair, poor, or unsatisfactory. The following points were considered in grading the transplantations:

1. The activity and power of the transplanted muscle.
2. The anatomical appearance of the extremity.
3. The stability and freedom from pain on long continued weight-bearing.

A satisfactory transplant has to contract with considerable power. Deformities should remain corrected, and the extremity should have a good appearance. The attachment of skin to tendon by the operative scar prohibits a grading of excellent. Usefulness of the extremity must be given a prominent place in judging the results of a transplanted tendon.

Table II shows the results arranged according to diagnosis. The excellent, good, and fair results were considered satisfactory. On this basis, 85 per cent. of all the transplants were useful.

In 5 per cent. of the 458 transplantations secondary operations, not including secondary stabilizations, were necessary. Most of these secondary operations were tendon transplantations.

POST-POLIOMYELITIC CASES

Age

Sometimes the question arises whether or not a post-poliomyelitic patient has reached an age when the optimum result can be expected from a tendon transplantation. The results were examined with this in mind. A rather sharp line of division was found between the group under eight years of age and the group over eight years. Table III shows that the percentage of successful results was greater in the older group than in the younger group. If we consider the excellent, good, and fair results satisfactory, then the transplantations done in children over eight years of age were 19 per cent. more successful than those done under eight years.

One might also ask whether a higher percentage of stabilizations were necessary in the older group than in the younger group. One would expect an affirmative answer, for there is a hesitancy to stabilize joints in patients under the ages of six and seven, because of the relatively large amount of cartilage present in these young bones. This was true. Stabilizations were 11 per cent. more frequent in the patients over eight years old than they were in those under eight years. This may account for some of the more successful results in the older group, but not for all of them. We must conclude that muscle transplantations are more apt to be successful in the older child. There are three reasons for this:

1. The deformity is more stable.
2. It is easier to evaluate the muscle imbalance.
3. Better cooperation is obtained from the older child in the important postoperative training period.

TABLE III

RELATION OF AGE TO RESULTS IN POST-POLIOMYELITIC CASES

Age Period (*Years*)	No. of Transplantations	End Results				
		Excellent (*Per Cent.*)	Good (*Per Cent.*)	Fair (*Per Cent.*)	Poor (*Per Cent.*)	Unsatisfactory (*Per Cent.*)
3 to 7	106	6	31	34	19	10
8 to 15	233	15	42	33	9	1

Deformities and Transplanted Muscles

It is interesting to note the most common types of deformities and their relation to results. Table IV shows that equinovalgus was the most frequent type of deformity among the post-poliomyelitic patients. Next came the varus foot. Remembering the commandment, "Thou shalt not varus," one might expect the results would be better with a valgus foot than with the varus, but instead the author found that the best results were obtained in the group with varus deformity and the poorest re-

TABLE IV

RELATION OF MOST FREQUENT TYPES OF DEFORMITY TO RESULTS IN POST-POLIOMYELITIC CASES

Deformity	No. of Transplantations	End Results				
		Excellent (*Per Cent.*)	Good (*Per Cent.*)	Fair (*Per Cent.*)	Poor (*Per Cent.*)	Unsatisfactory (*Per Cent.*)
Equinovalgus	58	5	38	33	21	3
Calcaneovalgus	33	3	48	36	9	3
Varus	22	23	59	14	4	0
Valgus	17	18	53	12	6	12
Equinovarus	14	21	29	43	7	0
Calcaneus	13	23	23	31	23	0
Cavovarus	10	0	70	30	0	0
Calcaneovarus	9	22	33	44	0	0
Peroneal Cavus	7	29	14	57	0	0

TABLE V

RELATION OF THE MUSCLES FREQUENTLY TRANSPLANTED TO RESULTS IN POST-POLIOMYELITIC CASES

Muscle	Weight * (*Grams*)	No. of Transplantations	End Results				
			Excellent (*Per Cent.*)	Good (*Per Cent.*)	Fair (*Per Cent.*)	Poor (*Per Cent.*)	Unsatisfactory (*Per Cent.*)
Tibialis Anterior	80	30	30	50	13	7	0
Peroneus Longus	62	61	7	39	46	8	0
Extensor Digitorum Longus	30	89	12	43	22	15	8
Peroneus Brevis	25	49	6	37	45	12	0
Extensor Hallucis Longus	18	75	8	37	32	16	7

* From Stoffel, as quoted by Whitman.[2]

sults in the group with equinovalgus, calcaneovalgus, and valgus deformities. Of course, the deformity with a calcaneal element would be difficult to correct, because of the rôle played by the strong gastrocnemius and soleus muscles, which of necessity would be replaced by comparatively small and inadequate muscles.

Table V shows the relation of the five most frequently transplanted muscles in the post-poliomyelitic cases. The better results occurred in the larger muscles. The tibialis anterior transplantations gave the best results and the extensor hallucis longus transplantations gave the poorest results.

An attempt was also made to evaluate results of the transplantations in relation to transplanted muscle and location of insertion, but these were so varied that it was impossible to draw any significant conclusions.

Preoperative Convalescence

In treating deformities of poliomyelitis, it has been considered good judgment to wait several years after the acute phase of the disease before operative correction, provided it has been possible to keep the deformity

TABLE VI

RELATION OF LENGTH OF CONVALESCENCE PRIOR TO OPERATION TO RESULTS IN POST-POLIOMYELITIC CASES

Years	No. of Transplantations	End Results				
		Excellent (*Per Cent.*)	Good (*Per Cent.*)	Fair (*Per Cent.*)	Poor (*Per Cent.*)	Unsatisfactory (*Per Cent.*)
1	2	0	100	0	0	0
2	7	0	57	43	0	0
3	46	4	33	37	22	4
4	33	6	43	33	18	0
5	48	10	48	25	10	6
6	38	11	26	42	11	11
7	26	8	27	35	23	8
8	27	15	37	37	11	0
9	25	20	52	16	4	8
10	21	5	52	38	5	0
11	16	38	44	18	0	0
12	16	31	38	31	0	0
13	12	8	0	92	0	0
14	5	40	20	0	0	40
15	1	0	100	0	0	0

TABLE VII

RELATION OF FOOT STABILIZATION TO RESULTS IN POST-POLIOMYELITIC CASES

	No. of Transplantations	End Results				
		Excellent (*Per Cent.*)	Good (*Per Cent.*)	Fair (*Per Cent.*)	Poor (*Per Cent.*)	Unsatisfactory (*Per Cent.*)
Primary Stabilization	211	11	43	30	13	2
No Stabilization	82	5	41	34	13	6
Before Secondary Stabilization	19	0	0	11	63	26
After Secondary Stabilization	19	37	16	47	0	0

from progressing during this time. Table VI was compiled with this point in mind. A comparatively large number of transplantations were done eight to twelve years after the acute onset of the disease. The author believes that there will be an increasing tendency to operate early in these cases because of: (1) the desire on the part of the surgeon to operate, (2) the insistence of the parents that something be done for their children, and (3) the demand on the part of public-welfare officials that economy be practised. Therefore, it will be progressively more unusual to find a group with such long convalescent periods prior to transplantation. A careful study of Table VI shows that lengthening the convalescence beyond two years had little effect upon the end results.

Stabilization

When considering doing a tendon transplantation in post-poliomyelitic foot deformities, one must decide whether or not a stabilization should be done as well. Should one attempt to correct the deformity by securing perfect muscle balance, and thus maintain as much mobility of the foot as possible? Or should one ensure permanent correction of the deformity by stabilization of the foot and consequent loss of motion?

Table VII shows the results with and without stabilization. The results were better with stabilization. In 19 per cent. of the cases in which the feet were not stabilized at the time of the transplantation, a later stabilization was necessary. When one considers that the poorer feet were stabilized at the time of the transplantation and still the results were considerably better in these cases than in those without stabilization, the evidence in favor of stabilization is impressive.

Insertion of Transplant

There are many types of insertions for transplants. Each type has its advocates. It is also found that here as elsewhere in surgery styles come and go. It is now generally considered good form to hold securely the bared end of the tendon in contact with the bone. There seems to be little choice, as judged from the end results shown in Table VIII, between

TABLE VIII

RELATION OF TYPE OF INSERTION TO RESULTS IN POST-POLIOMYELITIC CASES

Type of Insertion	No. of Transplantations	End Results				
		Excellent (*Per Cent.*)	Good (*Per Cent.*)	Fair (*Per Cent.*)	Poor (*Per Cent.*)	Unsatisfactory (*Per Cent.*)
Bone Tunnel with External Suture	2	0	50	50	0	0
Bone Tunnel with Internal Suture	136	13	40	26	15	6
Subperiosteal Suture	70	14	41	26	14	4
Bone Groove with Internal Suture	7	14	29	29	29	0
Osteoperiosteal Bridge	4	25	0	75	0	0
Interlaced with Tendon, Internal Suture	120	8	38	45	7	2

the various methods used. In choosing the method of inserting the tendon, the simplest and most expedient should be the best. Since January 1931, Dr. Hatt has been using the bone tunnel with external suture of the tendon, as suggested by Dr. Wallace Cole.

In the technique followed by him the tendon being transplanted is

TABLE IX

CAUSES OF FAILURE TO OBTAIN PERFECT RESULTS IN POST-POLIOMYELITIC CASES

Cause of Failure	No. of Transplantations
Original weakness of transplanted muscle	53
No stabilization done	25
Weak transplant, previously rated good	24
Too small muscle mass	23
Disturbance of muscle balance	23
Attachment of transplant to skin	10
Extensive general paralysis	7
Inactivity of transplant, previously active	7
Undertransplanted (transplanted too far medially or laterally)	7
Overtransplanted (transplanted too far medially or laterally)	4
Wrong choice of transplant insertion	4
Delayed stabilization	4
Overcorrection	3
Incomplete stabilization	3
Ganglion	2
Transplant pulled loose	2
Transplant caught deep in scar	2
Overlengthened tendo achillis	1

TABLE X

RELATION OF AGE TO RESULTS IN CONGENITAL EQUINOVARUS

Age (*Years*)	No. of Transplantations	End Results				
		Excellent (*Per Cent.*)	Good (*Per Cent.*)	Fair (*Per Cent.*)	Poor (*Per Cent.*)	Unsatisfactory (*Per Cent.*)
1	6	17	0	33	50	0
2	10	70	10	10	10	0
3	8	37	12	12	25	12
4	13	31	46	15	8	0
5	10	20	40	20	20	0
6	4	25	75	0	0	0
7	10	60	20	20	0	0
8	5	0	20	80	0	0
9	4	0	50	50	0	0
10	1	0	0	100	0	0
11	1	100	0	0	0	0
12	1	0	100	0	0	0
13	1	0	100	0	0	0

TABLE XI

RELATION OF TYPE OF TRANSPLANTATION TO RESULTS IN CONGENITAL EQUINOVARUS

Type	No. of Transplantations	End Results				
		Excellent (*Per Cent.*)	Good (*Per Cent.*)	Fair (*Per Cent.*)	Poor (*Per Cent.*)	Unsatisfactory (*Per Cent.*)
Tibialis Anterior to Anterior Part of Calcaneum	1	0	100	0	0	0
Tibialis Anterior to Cuboid	25	28	36	28	8	0
Peroneus Longus to Fifth Metatarsal Base	2	0	100	0	0	0
Peroneus Longus to Peroneus Brevis	23	35	48	17	0	0
Tibialis Anterior to Peroneus Tertius	3	67	0	0	33	0
Tibialis Anterior to Third Cuneiform	17	53	24	12	12	0
Tibialis Anterior to Second Cuneiform	3	33	33	33	0	0

isolated, divided, and brought to its new location. Care is taken to preserve the paratenon and mesotenon and to transplant through sheaths of the paralyzed muscles where possible.

The tendon is trimmed so that the end will come just through the bone. Its distal end is cleaned of paratenon by a knife and a piece of gauze. The point of insertion is bared, and a tunnel is made through the bone with a drill point, three-sixteenths of an inch in diameter, held in an awl handle. The proximal end is widened slightly by a reaming action of the drill. A grooved director is passed through the tunnel. A heavy, waxed, braided, silk thread is laced into the end of the tendon, using a long, straight needle and making from four to six stitches. Both ends of the thread are drawn through the needle, and the needle is passed along the director, pushed through the skin, and pulled out on the far side. The director is left in the tunnel until the tendon is being pulled through. The thread is tied over a gauze sponge while the desired tension on the transplanted tendon is maintained. Then one or two light silk sutures are taken to secure the tendon to deep fascial layers and periosteum at the proximal end of the tunnel. Dr. Hatt calls this the "insurance suture". The wound is closed. The external suture is easily pulled out when the cast is changed, usually at the expiration of four weeks. The advantages of the method are:

1. It is quick.
2. It is easy to execute.
3. The proper amount of tension can be maintained while the tendon is secured to its new insertion.
4. The point of insertion can be located accurately.
5. A firm insertion is made.

The only disadvantage is that it leaves for four weeks a sinus extending into the bone along the external suture. However, this has not caused trouble.

Causes of Failures

The study of the causes of failure to obtain *perfect* results has been interesting. A glance at Table IX shows that most failures were due to errors in surgical judgment rather than to errors in surgical skill. This is an important point and one which we younger men are apt to overlook. Here, as in other branches of surgery, it is far more important to know what, when, and how a procedure is to be done than it is to be able to carry out an operation with the greatest technical skill. In a few rare individuals we find both qualities, and these men stand out as the real leaders in our profession.

CONGENITAL EQUINOVARUS CASES

In the cases of congenital equinovarus, we find that the good results were about the same for the various age groups. Table X, however, shows that all the poor and unsatisfactory results occurred in the children

TABLE XII

RELATION OF TYPE OF INSERTION TO RESULTS IN CONGENITAL EQUINOVARUS

Type of Insertion	No. of Transplantations	End Results				
		Excellent (*Per Cent.*)	Good (*Per Cent.*)	Fair (*Per Cent.*)	Poor (*Per Cent.*)	Unsatisfactory (*Per Cent.*)
Bone Tunnel with External Suture	10	20	30	30	20	0
Bone Tunnel with Internal Suture	16	31	50	19	0	0
Subperiosteal Suture	19	53	21	21	5	0
Bone Groove with Internal Suture	3	0	67	33	0	0
Osteoperiosteal Bridge	2	50	0	0	50	0
Interlaced with Tendon, Internal Suture	20	40	45	10	5	0
Internal Suture to Another Tendon	4	25	50	25	0	0

under six years of age. This is an argument for more conservative treatment of young children. Plaster casts with wedgings and gradual correction of the deformities gave better results than the more radical procedures in the early cases. Nevertheless, in the stubborn and recurrent cases, transplantation of an unruly anterior tibialis muscle to gain muscle balance was a great help in maintaining correction of the deformity.

Table XI presents the various types of transplantations used. The transplantation of the peroneus longus to the peroneus brevis was used for a time, but it was discontinued because it was found that the unop-

TABLE XIII

CAUSES OF FAILURE TO OBTAIN PERFECT RESULTS IN CONGENITAL EQUINOVARUS

Cause of Failure	No. of Transplantations
Disturbance of muscle balance by transplantation of peroneus longus to peroneus brevis	9
Overtransplanted	5
Undercorrected	3
Weak transplant	3
Cyst	2
Inactivity of transplant	1
Disturbance of muscle balance	1

TABLE XIV

RELATION OF TYPE OF INSERTION TO RESULTS IN CEREBRAL SPASTIC PARALYSIS, SEVERED TENDON, AND MISCELLANEOUS CASES

Type of Insertion	No. of Transplantations	End Results				
		Excellent (*Per Cent.*)	Good (*Per Cent.*)	Fair (*Per Cent.*)	Poor (*Per Cent.*)	Unsatisfactory (*Per Cent.*)
Bone Tunnel with Internal Suture...	16	0	75	13	13	0
Subperiosteal Suture	6	0	0	50	17	33
Osteoperiosteal Bridge	0	0	0	0	0	0
Bone Insertion with Internal Suture...	3	0	67	33	0	0
Bone Mortise.....	8	0	0	88	13	0
Graft.....	3	0	67	0	33	0
Interlaced with Tendon, Internal Suture.....	9	11	0	67	22	0

posed anterior tibialis muscle became even more active than previously. In the latter period of this study, the transplantation of the anterior tibialis tendon to the outer side of the foot was the method of choice.

Here again in Table XII we find that there was no particular difference in the results obtained by the various methods of securing the insertion of the transplanted tendons.

Table XIII shows the causes of failure to obtain *perfect* results in the cases of congenital equinovarus. The mistake of transplanting the peroneus longus to the peroneus brevis has already been mentioned. The formation of ganglia or cysts at the insertions of these tendons probably shows that trauma is a direct cause of the production of these ganglia in unoperated cases.

MISCELLANEOUS CASES

In the few cases of cerebral spastic paralysis, transplantation of tendons was not effective in combating the deformity. Lack of stabilization was mentioned as the cause of failure in two cases, and, in the others, mental deficiency was a greater handicap than the physical disability.

In one late case of a severed tendon, the fragments failed to unite when sutured together, and, in another, the tendon became attached to the skin by scar tissue.

In cases of Charcot-Marie-Tooth peroneal paralysis, transplanted tendons were found inefficient in maintaining correction of the deformity.

In Table XIV, which includes cases of cerebral spastic paralysis, cases of severed tendon, and miscellaneous cases, we notice that, in addi-

tion to the regular types of insertion of the tendon, a number of the transplants were inserted with a bone mortise. These operations were done for knee-flexion deformity associated so frequently with cerebral spastic paralysis. The patellar tendon, with a piece of the bone at the point of insertion, was removed from the tibia and inserted from the medial aspect into a slot cut lower down on the tibia. This immediately made a very firm attachment, and even the strong spasmodic contractions in these individuals did not loosen the insertions. This procedure is not wholly successful, however, because the tightened tendon stretches out later on.

SUMMARY

1. In an end-result study of 458 tendon transplantations, it was found that 85 per cent. of these operations gave satisfactory results.

2. Tendon transplantations in children over eight years of age with post-poliomyelitic deformities yielded better results than in younger patients.

3. Of the deformities in post-poliomyelitis, the varus foot gave the best results.

4. In tendon transplantations in the post-poliomyelitic cases, the larger muscles gave the better results.

5. A convalescent period of over two years after the acute phase of anterior poliomyelitis did not increase the number of satisfactory tendon transplantations.

6. Stabilization increased the number of satisfactory tendon transplantations. In 19 per cent. of the cases in which tendon transplantations were done without stabilization, secondary stabilizations were necessary.

7. The type of insertion of the transplant should be simple and expedient. A method of bone tunnel with external suture is recommended.

8. An analysis of the causes of failure to obtain *perfect* results showed that errors in surgical judgment were more frequent than errors in surgical skill.

9. In the cases of congenital equinovarus, good results were fairly evenly distributed in the age groups. However, the poor and unsatisfactory results occurred in the children under six years.

10. Transplantation of the tendon of the tibialis anterior to the middorsum of the foot was the most successful procedure in cases of congenital equinovarus.

11. Transplantation of tendons in cases of cerebral spastic paralysis and in those of Charcot-Marie-Tooth peroneal paralysis was not efficient.

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2. Whitman, Royal: A Treatise on Orthopaedic Surgery. Ed. 9, p. 932. Philadelphia, Lea & Febiger, 1930.

BLIND NAILING OF THE T FRACTURE OF THE LOWER END OF THE HUMERUS WHICH INVOLVES THE JOINT *

BY O. L. MILLER, M.D., CHARLOTTE, NORTH CAROLINA

It is generally conceded that an intercondylar or T fracture of the elbow joint will result in varying degrees of disorganization of that joint and permanent disturbance of its function. All the factors that eventually contribute to the disability of an elbow so injured, we may not know. However, we assume that the more promptly and accurately an intercondylar fracture is reduced the better the functional end result will be.

It is a fact that the more anatomically accurate is the reduction of a fracture, the less will be the amount of callus deposited in the process of bone repair. Since little provision is made for the accommodation of callus within the capsule of a joint without seriously disarranging the component elements of the joint, and consequently the joint function, it is important to obtain accurate reduction of joint fractures.

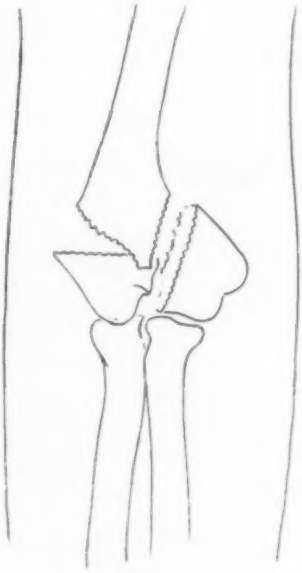

FIG. 1

Anteroposterior view of intercondylar T fracture.

In a T fracture of the elbow there is, of course, extensive reaction in the overlying soft structures, in addition to trauma of the bone. In the past, open operation has at times been resorted to in an effort to obtain accurate reduction of these joint fractures. While open reduction may be preferable to a poor closed reduction, it certainly entails much additional trauma to the soft parts. Some of this trauma will affect structure not hitherto involved in the injury.

In a paper read before the American Orthopaedic Association in 1936, Dr. Rudolph S. Reich [1] discussed the cause and mechanics of intercondylar fractures of the elbow and demonstrated a very ingenious apparatus to be used in the treatment of these fractures. The apparatus described was a combination of ice-tong traction and a Jones humerus splint. This permitted the patient to be ambulatory, and the method of management would certainly seem preferable to open reduction.

Being somewhat intrigued by the thought as well as the art of blind pinning or nailing of fresh fractures in various parts of the body, the

* Read at the Annual Meeting of the American Orthopaedic Association, Buffalo, New York, on June 7, 1939.

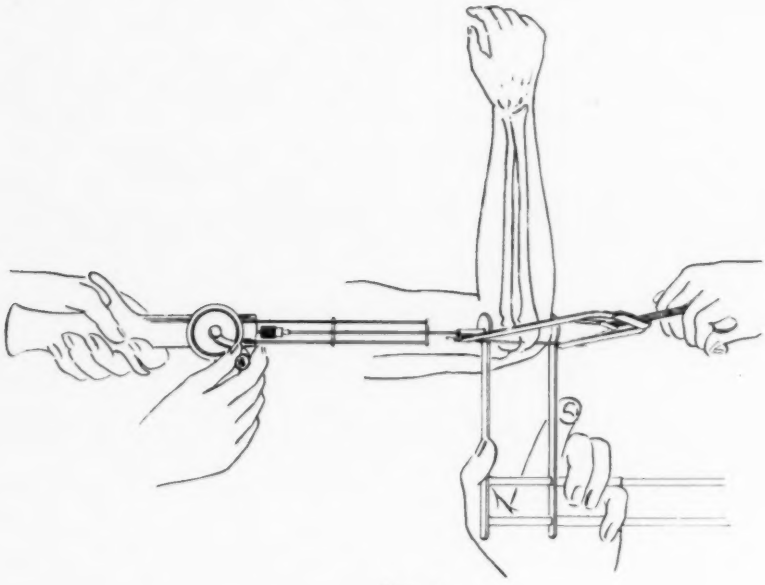

FIG. 2

Elbow in position for reduction of intercondylar fracture and insertion of Kirschner wires.

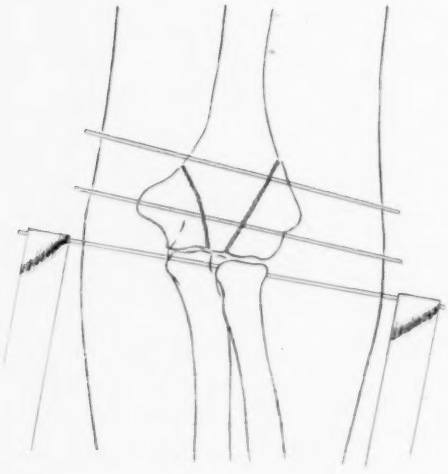

FIG. 3

Showing traction applied, fracture reduced, and nails in position.

writer had occasion some two years ago to try transfixing the fragments of bone involved in an intercondylar or T fracture of an elbow by the so-called blind-nailing method. It worked out very satisfactorily in the first case, and it is the purpose of this paper to report experience with a small series of cases so treated, and to recommend the procedure.

TECHNIQUE OF OPERATION

The operation is carried out as follows: With the patient under general anaesthesia, a Kirschner wire of medium caliber is driven through the olecranon process, and a wire-tightening apparatus is applied to this wire. With the elbow flexed to a right angle, strong traction is applied along the shaft of the humerus. This traction, plus molding pressure over the condyles, should reduce a fresh fracture. A Kirschner-wire guide is then placed astride the articular processes, and a wire is driven through at this level. A second wire is driven through the

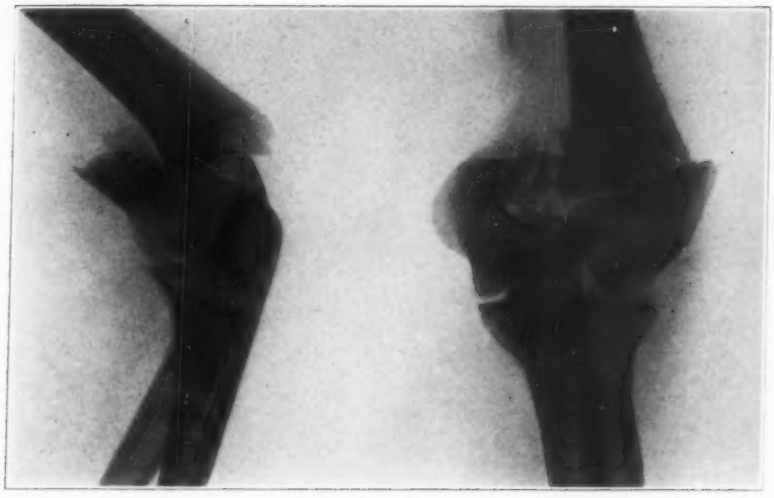

FIG. 4-A

Lateral and anteroposterior views of intercondylar T fracture.

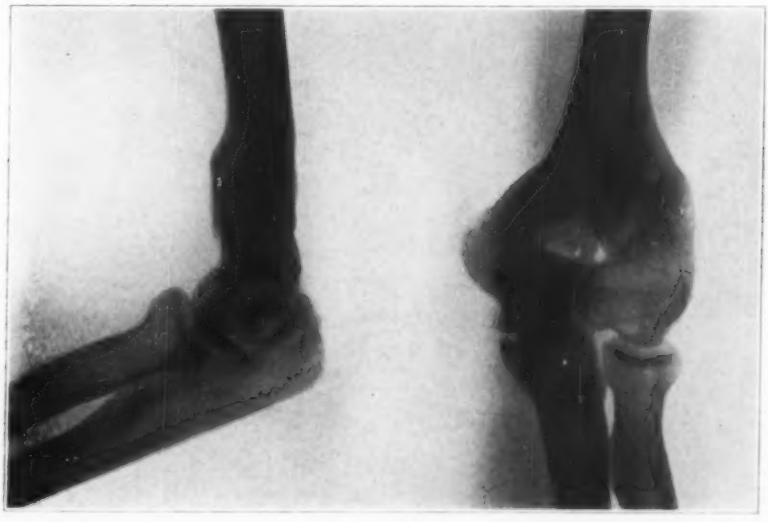

FIG. 4-B

Lateral and anteroposterior views three months after reduction by blind nailing.

condyles, and a third one is inserted above the condyles to transfix at least one of the fragments to the shaft of the humerus. The wires are then clipped just outside the skin, and a light arm cast is applied, with the elbow flexed in the position maintained during the operation. The wire-tightening apparatus should be left on the wire driven through the olecranon process until a roentgenogram has been taken. If the position of the fractured fragments should not prove satisfactory, the method

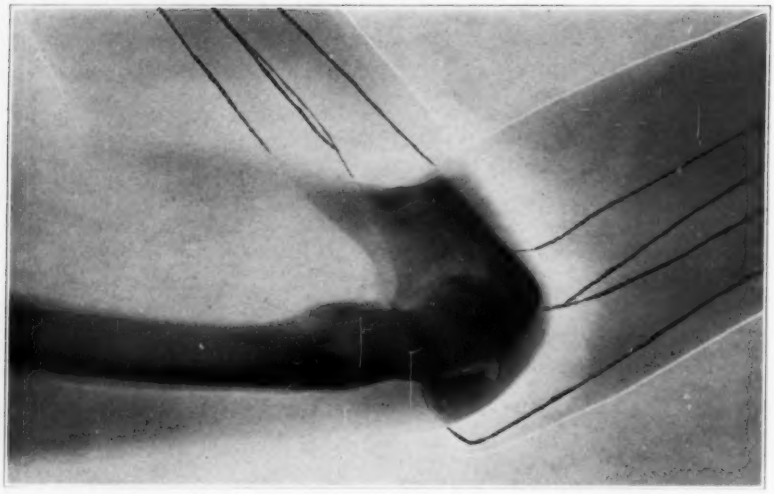

FIG. 4-C

Range of motion one year after termination of treatment.

could be abandoned and the treatment continued with some form of traction. The writer has not had occasion so far to resort to the latter procedure in a single case treated by blind nailing.

The nails used to transfix the fractured fragments in the position of reduction may be and are easily and painlessly removed by means of a drill chuck within from four to six weeks, or when consolidation of the fracture has advanced to a degree where moderate motion in the joint may be instituted. The usual postoperative care is then carried out.

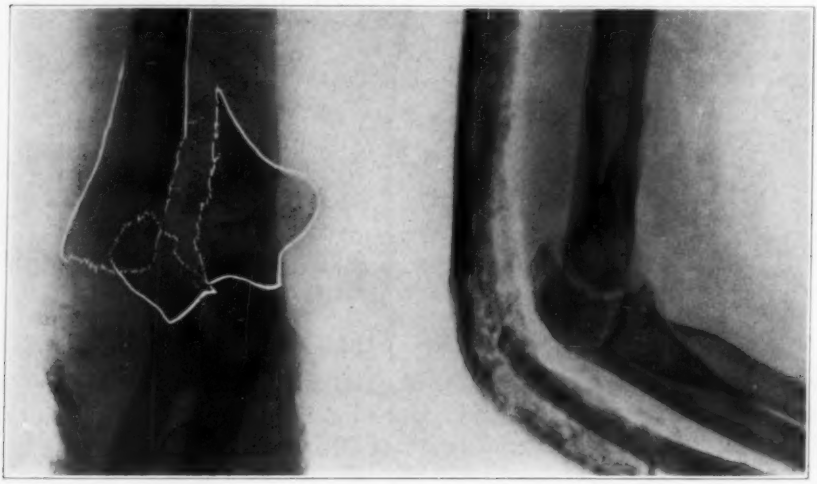

FIG. 5-A

Anteroposterior and lateral views of intercondylar T fracture.

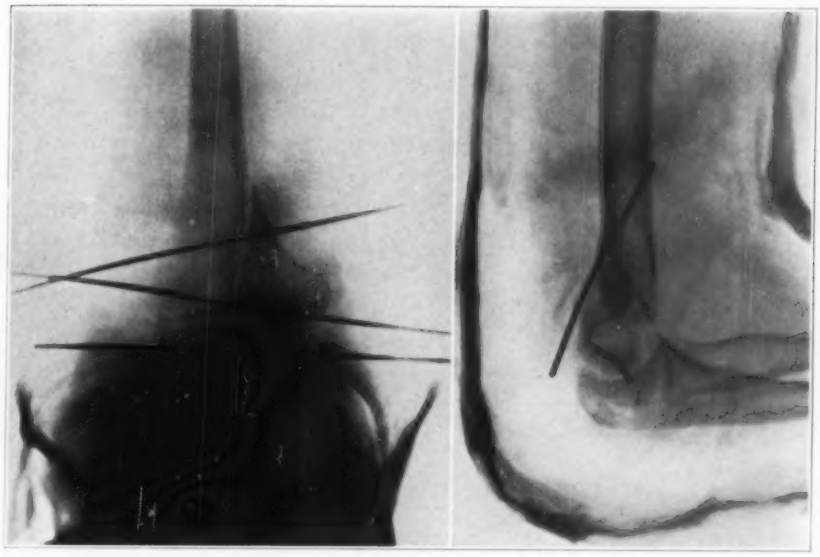

FIG. 5-B
Intercondylar T fracture reduced with nails in position.

CONCLUSIONS

Accurate blind nailing of intercondylar fractures of the elbow is quite possible and is accomplished comparatively easily.

The procedure has evident advantages over open reduction. It en-

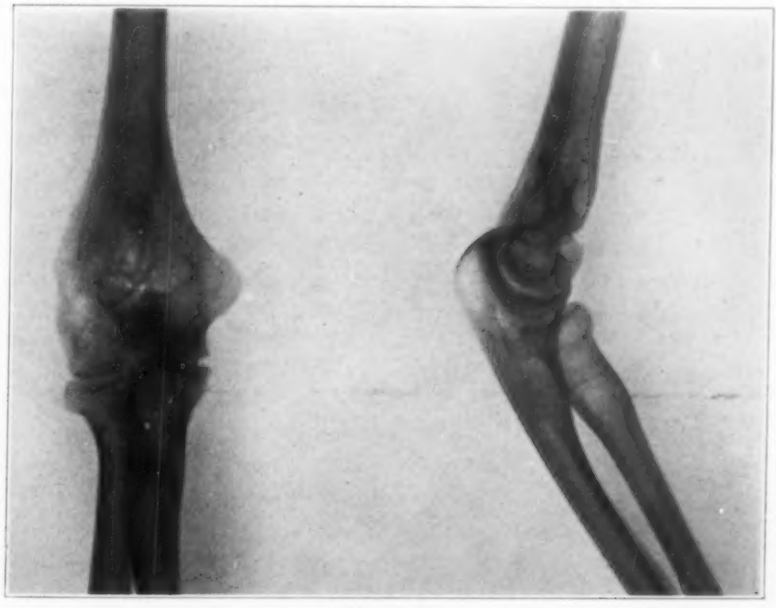

FIG. 5-C
Appearance of joint fifteen months after termination of treatment.

tails less damage to the soft parts, and it materially shortens the hospital stay.

If blind nailing should not succeed in the hands of an operator, other methods of treatment are by no means jeopardized.

In the author's experience, more accurate anatomical reduction of the fracture and better functional results in the joints have been obtained with this method than by other procedures.

1. Reich, R. S.: Treatment of Intercondylar Fractures of the Elbow by Means of Traction. J. Bone and Joint Surg., XVIII, 997, Oct. 1936.

TREATMENT OF OBSTETRICAL FRACTURES OF THE FEMUR

BY ARNOLD PAVLÍK, M.D., BRNO, CZECHO-SLOVAKIA

From the Orthopaedic Clinic, Masaryk University, Brno*

Clinical experience has demonstrated that obstetrical fractures of the femur are frequently cured without shortening, in spite of the fact that the original lateral and longitudinal displacement of the fragments has been considerable. The most frequent fracture of the femur during childbirth occurs in the cartilaginous portion of the femoral neck or in the upper and middle thirds of the shaft. The fractures of the diaphysis are more or less oblique, with very marked displacement. Fractures of the upper cartilaginous portion of the neck give the impression of a traumatic dislocation, but they really are fractures. In these cases, the cartilaginous portion of the future neck and head is torn off, but remains in the cavity of the joint, where the upper end of the femur is visible in the roentgenogram. The difference in length of the lower extremities in these cases is striking, as there is shortening of the fractured limb of several centimeters, which is very important when one considers that the length of the femur in the infant is only about ten centimeters.

In the treatment of these fractures it is always difficult to obtain longitudinal reduction of the displaced fragments and to retain them in the normal, or even approaching the normal, position. The usual treatment of these obstetrical fractures is by means of vertical extension. Plaster extension is applied to the limb, and the child is practically suspended by his broken limb, so that the extension is obtained by his own weight. This method has the following disadvantages: (1) it is necessary that the child remain in the hospital; (2) it is difficult for the mother to nurse the child; and (3) frequently the appearance of a decubitus, eczema, or similar conditions makes it necessary to change or to discard the extension. The application and maintenance of the extension are difficult and do not result in reposition of the fragments in true alignment longitudinally and laterally. Considering the fact that the fragments are not placed end to end, a definite displacement remains.

Because of these disadvantages, Přof. Bedřich Frejka has discarded this method and has introduced the treatment by a plaster bandage similar to that used in congenital dislocation of the hip. Extension does not succeed in producing a reposition of the displaced fragments in true alignment, and it is this deviation which should have first consideration, for, if the fragments unite in the wrong axis, with outward or inward rotation, there may result considerable static defects of the hip joint, — namely, coxa vara, coxa valga, anteversion or retroversion of the neck, external rotation of the femur, or angular deformity of the diaphysis.

* Chief: Prof. Bedřich Frejka, M.D.

FIG. 1-A

Case 1. Obstetrical fracture of the left femur in an infant, one day old. The femur is fractured horizontally above the middle third, with lateral and longitudinal displacement from its true axis. The length of the upper fragment is 3.4 centimeters and that of the lower fragment is 5.3 centimeters, so that the real length of the femur should be 8.7 centimeters. However, the length of the fractured femur is 7.6 centimeters; consequently, there is shortening of 1.1 centimeters.

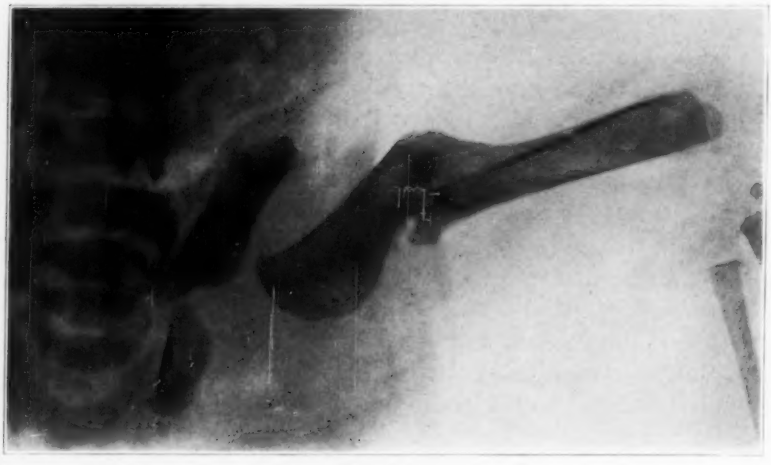

FIG. 1-B

Case 1. Roentgenogram of the left femur at the age of five weeks. Callus has formed between the two fragments, but the position of the fragments is unchanged.

The main principle of the method devised by Prof. Frejka is the retention of the limb in the position of abduction. By this means, it is possible to correct the angular deviation. The lateral and longitudinal displacement may remain. The shortening of the extremity is then obviated by the overgrowth, which is rapid in infants and equalizes the difference in the length. The reposition of the fragments by the abduction of the limb

FIG. 1-C

Case 1. Roentgenogram of the left femur at the age of seventeen months, showing complete consolidation of the fracture. There is a deviation of about 10 degrees of the axis in the middle third of the femur; the axis of the neck and that of the upper part of the femur are normal. The length of the right femur is 18.1 centimeters and that of the left femur is 17.8 centimeters. The left femur is shortened by 0.3 of a centimeter only. Since the original shortening amounted to 1.1 centimeters, there has been an overgrowth of 0.8 of a centimeter. It is probable that the slightly divergent longitudinal axis of the femur will be still further corrected.

is maintained by a plaster bandage symmetrically applied to both lower extremities.

The treatment suggested has the advantage of simplicity. It does not require hospitalization of the patient. In only a few cases has it not been possible to carry the child about during treatment. Reposition of the fragments is relatively easy without narcosis. During the first month, the plaster bandage is changed each week; the final bandage is worn for one month, so that the treatment is usually terminated at the end of two months. At this time, the callus is sufficiently strong.

During the past three years, we have been treating all obstetrical fractures of the femur by means of plaster bandages. In each case, the fragments have healed satisfactorily without shortening of the limb or with shortening of only a few centimeters. In most cases, the position of the neck is normal. If coxa valga occurs, it is less serious than coxa vara, since the former corrects itself during growth, while the latter tends to increase. It has been an interesting observation that during treatment by plaster with the limb in abduction coxa vara is never produced, while during treatment by extension this deformity frequently occurs.

FIG. 2-A

Case 2. Obstetrical fracture of the left femur in an infant seventeen days old. There is displacement of the fragments in every direction, with considerable shortening of the femur and an irregularly developed bone callus.

The question is how to explain the overgrowth in length of bone following fractures in infants and in adults. It is known that a limb increases in length if it is injured by some pathological condition either in the joint or in the bone. This may be due to tuberculosis, osteomyelitis, lues, hemophilia, or mixed infections. Overgrowth is the result of hyperaemia occurring not only in the immediate vicinity of the inflammatory layer, but also reaching to the zones of growth remote from the primary site of the inflammation. Fractures in long bones are equally conducive to overgrowth as a result of hyperaemia. This increased growth, however, is not located at the site of the fracture, but rather at the epiphyseal cartilage. In infants, traumatic hyperaemia during the period of healing is

very intensive, so that the broken limb outgrows the uninjured one. In adults, overgrowth is less striking, as the growth processes are slower. Where displacement has complicated a fracture, the overgrowth often equalizes the shortening.

FIG. 2-B

Case 2. Roentgenogram at the age of twenty-seven months, showing complete consolidation of the fracture with slight obliquity of the neck of the left femur. The neck has united with the shaft at an angle of 160 degrees. The length of the right femur is 19.0 centimeters and that of the left femur is 18.7 centimeters, making the left femur 0.3 of a centimeter shorter than the right. In view of the considerable displacement of the original fracture and the marked shortening of the limb, lengthening of the fractured femur by overgrowth has taken place.

The entire arterial system in the fractured bone reacts to the trauma by an engorgement of veins and arteries. The periosteal and endosteal network of vessels is abundant, both at the site of the fracture and in more remote areas. The healing of the fracture depends upon the flow of arterial blood, both as to time and to duration. Hyperaemia reaches its height at about the end of the fifth week after the fracture. One week after the fracture, an increase of the periosteal and endosteal vessels may be observed, their engorgement extending up to the site of the fracture. First, the periosteal network develops, forming collateral anastomoses with torn vessels in the marrow. Collateral circulation in fractures of the diaphysis shows that the more distant vessels of the metaphysis are engorged. The nearer the fracture is to the metaphysis, the more effective are the metaphyseal collaterals.

Blood flows from the metaphyseal side, chiefly from vessels of the periosteum, through the metaphyseal anastomosis with branches to the nutrient artery and through these again to the scattered vessels of the marrow. Beginning with the second week, the rich periosteal network puts forth large vessels into the fracture and later into the cortex at the ends of the fragments. During the displacement of the fragments, periosteal vessels project themselves into the marrow cavity. In this cavity anastomoses with the nutrient vessels take place. In this way the injured part of the marrow gets arterial blood from both sides. Without this arrangement, the marrow would not be able to participate in the formation of callus. Marrow callus is thus formed later than periosteal

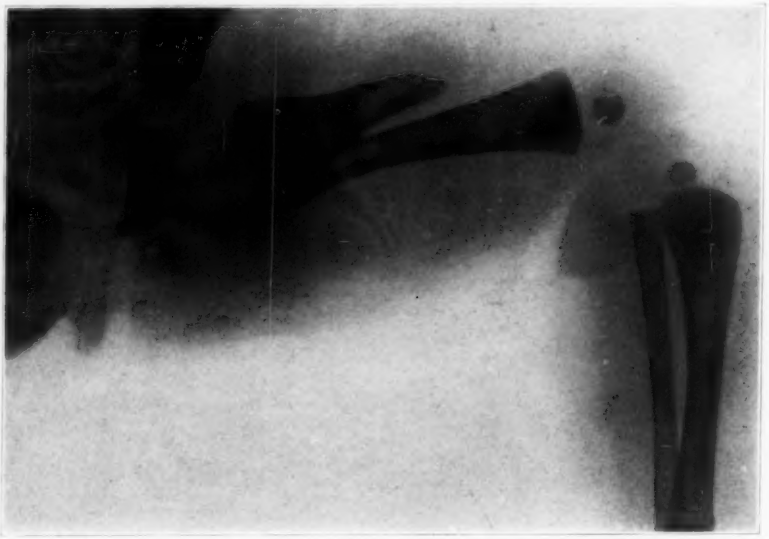

FIG. 3-A

Case 3. Obstetrical fracture of the left femur in an infant, one day old. There is an oblique fracture of the femur with displacement in all directions. The length of the fractured femur is 7.0 centimeters, whereas the total length should be 8.1 centimeters; consequently there is shortening of 1.1 centimeters.

callus. In fractures through the nutrient foramen, both fragments are equally affected. If the fracture is either above or below this nutrient foramen, one of the fragments will have an undisturbed circulation,

FIG. 3-B

Case 3. Roentgenogram at the age of two years, showing complete consolidation of the fracture. There is marked obliquity of the axis of the neck, so that it is nearly parallel with the axis of the femur. The real length of the left femur is 18.8 centimeters, while that of the right femur is 19.0 centimeters; thus the left femur is 0.2 of a centimeter shorter than the right. If the normal position of the neck were considered, the shortening would be more. A slight subluxation has been produced, Shenton's line is disturbed, and the neck is probably in anteversion.

whereas the other will have none at all. In the fragment having good circulation, there will be a more rapid production of the vessels, and an attachment of the periosteal network of vessels takes place. This represents the nutritive hyperaemia occurring during the first week after the fracture. In the other fragment, from four to five weeks are required before a collateral hyperaemia develops between the periosteal and the metaphyseal vessels and before nutrition can be equal on both sides of the fracture. In oblique or comminuted fractures, adjustment of collateral circulation is much prolonged. The periosteum plays a very important part in the healing of fractures, and, if nutrition in bone from this source is damaged by trauma, or if the soft parts are separated from the periosteum, the nutrient artery is excluded from circulation in the first period and anastomosis with the periosteal network is lessened. Later it may be restored, depending upon the severity of the injury. The most favorable conditions exist in the metaphysis, for there the vessels are larger. The metaphysis is also well supplied with vessels by the periosteum and by the terminals of the nutrient arteries.

It is quite comprehensible, therefore, that, in the case of a simple fracture of the diaphysis in childhood or in infancy, the entire arterial system—not only at the site of the fracture, but also throughout the diaphysis—may be in full activity, thus providing nutritive conditions in the epiphyseal cartilage, which make possible an overgrowth of the limb. Moreover, it is evident that overgrowth in the fractured limb ceases just as soon as complete healing of the fracture has taken place, at which time hyperaemia also wholly ceases.

CASE REPORTS

Case 1 (Figures 1-A, 1-B, and 1-C). An infant, one day old, was brought to the Orthopaedic Clinics with a fracture of the upper third of the left femur, which had occurred during delivery by version. After reposition of the fragments, a plaster bandage was applied with the limbs in a position of maximum abduction. Immobilization of the left limb was maintained for eight weeks, the last bandage being worn for four weeks. At the end of this immobilization period, complete consolidation of the fracture had taken place. The child began to walk at the age of eleven months without any sign of defect in the left lower extremity.

Case 2 (Figures 2-A and 2-B). The fracture occurred during a difficult delivery and, on account of the condition of the infant, no treatment could be instituted for seventeen days, at which time both the mother and the child were treated. Following the fracture, there was shortening of the left lower extremity, with a hard infiltration of the whole length of the femur. Clinically, the fracture was considered to have united, in spite of the fact that a plaster bandage had been applied to both limbs in abduction. The left limb was immobilized for a total period of six weeks. Twenty-seven months after injury, the fracture could not be seen in the roentgenogram. The axis was normal and, with the exception of slight obliquity of the neck, the left femur was normal. No difference in length of the extremities could be determined clinically. Roentgenographic examination showed a shortening of the left femur amounting to three-tenths of a centimeter. The gait was normal.

CASE 3 (Figures 3-A and 3-B). In this infant, one day old, a fracture of the left femur above the middle had occurred during delivery by version. After reposition of the fragments with the limbs in abduction, a plaster bandage was applied. This was worn for three months. During the first month, the plaster was changed every week; during the last two months, it was changed each month. The result at the end of two years is excellent, in spite of the marked original shortening. There is slight anteversion of the neck, which may require later treatment.

SUMMARY

Prof. Frejka has discarded the treatment by extension of fractures of the femur in infants and has adopted the treatment by a plaster bandage with the limbs in abduction. This treatment was introduced after experience had demonstrated that extension is not necessary to obtain satisfactory results in infants. It is only necessary to replace the fragments in true alignment, which is the first consideration. Replacement of the fragments is best obtained by the abduction of the limbs in a plaster bandage in the same manner as in the treatment of congenital dislocation of the hip. In the case of a longitudinal displacement, in spite of the fact that the fragments are not replaced, the shortening is compensated during the healing process by overgrowth, so that finally both lower limbs are the same length. If the fragments are not replaced in true alignment, various defects of the hip joint—such as coxa vara, coxa valga, anteversion or retroversion of the neck, or associated defects—may follow.

THE DIAGNOSIS AND TREATMENT OF ATHETOSIS AND DYSTONIA *

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Many textbooks [19] and even special articles [12] consider "cerebral palsy" as a unitary subject, and describe one set of principles of treatment for all varieties. Recent neurological investigations indicate that a subdivision of the field is important, not only for scientific purposes, but also in prognosis and in treatment.

Three main types of "spasticity", "rigidity", or "cerebral paralysis" may be recognized at present,—hemiplegia, parkinsonian rigidity, and athetosis or dystonia. There are doubtless others.

HEMIPLEGIC SPASTICITY

This type includes monoplegia or hemiplegia resulting from injury to the motor and "premotor" cortex. According to Fulton [10] and his collaborators, this syndrome may be further subdivided into those symptoms which are the result of injury to the motor cortex or pyramidal tract,—weakness, awkwardness, and flaccidity of the corresponding limb; and those which are caused by injury to the premotor cortex,—spasticity and increased reflexes. However, the distinction is rarely possible in clinical practice. There can be no doubt that bilateral injury to the motor cortex (for example, of the legs, on the mesial side of the hemisphere) leads to a more profound weakness and spasticity of both sides than occurs on either side from a unilateral lesion.

The usual picture of hemiplegia from a cortical lesion is that of the flexed arm and extended leg, which are relatively weak and lacking in dexterity. There is an increase in the deep reflexes and in the extensor response of the toes. The spasticity affects almost exclusively the "antigravity" muscles; the triceps, for example, is relaxed and weak. Involuntary movements do not occur when the lesion is confined to the cortex or to the pyramidal tract.

Physiological examination of severe cases shows that almost the only possible type of voluntary innervation is a mass movement of large portions of an extremity,—for example, of a hand, with little separate use of the fingers. The inexactness of the movement is due not only to a lack of differentiation of individual muscles, but also to a loss of the asynchronous innervation of individual motor units within each muscle, which is responsible for the smoothness of normal contraction.[13, 14] The spasticity is mitigated by section of posterior roots (the Abbe-Foerster operation), and

* Read before the Boston Orthopaedic Club, Boston, Massachusetts, on March 13, 1939.

it is in selected cases of true hemiplegia in which there is fair preservation of power, hampered by spasticity, that posterior rhizotomy should find its greatest usefulness. It certainly cannot be expected to benefit the other types of rigidity.

PARKINSONIAN RIGIDITY

This is demonstrated in its purest and most striking form in the victims of juvenile paralysis agitans, such as that seen as a sequel of epidemic (lethargic) encephalitis. It is well described in the words of Hughlings Jackson as "tremor run together", and often myograms or even palpation will reveal a tremulous element. As in the obvious tremor of paralysis agitans, agonists and antagonists contract in bursts alternately at a fairly constant rate of six to ten per second, and the rigidity is caused by a confluence of bursts affecting both agonists and antagonists.

Electromyographic studies show further that in the bursts of contraction, all of the motor units of the muscles involved discharge practically simultaneously.[15] This, as we have seen, is a characteristic of the innervation of spastic (hemiplegic) muscles also, and is in contrast to the smooth, sustained, polyrhythmic innervation of motor units in normal contraction.

Both the tremor and the rigidity of this type are sometimes strikingly improved by drugs of the atropine series and amphetamine (benzedrine), which do not affect other types of "spasticity". Rigidity, but not tremor, is decreased at least temporarily by section of posterior roots [9, 30] or posterior columns,[35, 36] but not by section of the extrapyramidal tracts.[32] Tremor has been ameliorated by removal of the motor and premotor cortex [4] or by section of the pyramidal tract.[33]

ATHETOSIS AND DYSTONIA

As these conditions are the ones chiefly under consideration here, they will be described in greater detail. The two terms refer to an apparently similar physiological mechanism, which expresses itself in the former case by abnormal involuntary movements and in the latter by involuntary postures. Either or both may coexist with severe injury to the pyramidal tract or with an alternating (parkinsonian) tremor. The disorder may affect the muscles of articulation alone, the face, the neck alone (torticollis), one extremity, both extremities of one side, both arms, the trunk, or almost the entire skeletal musculature. Ordinary clinical observation reveals at once that the involuntary movements shift irregularly from one group of muscles to another, that they are increased by effort or emotion, that the contractions are smooth, powerful, and sustained, and that there is simultaneous innervation of agonists and antagonists.[42] The fingers are ordinarily extended on the hand, and the great toe on the foot, in a posture wholly unlike that of hemiplegia. The movements cause a great output of energy, sweating, and a marked rise in "basal" metabolism, unlike the tremor of paralysis agitans.

Electromyographic studies show further that there is an asynchronous discharge of motor units resembling that of normal voluntary innervation, except that it is not within reach of volition, and that there is no normal relaxation of the opposing muscles;[16] hence, of course, the squirming and the distortion.

The abnormal movements and postures are not particularly affected by section of posterior roots, as are the other types of "spasticity" and "rigidity". This is one of the reasons for the present undeserved ill repute of the operation. Nor are peripheral-nerve sections effective; they are likely to lead merely to a reverse of the deformity. Fixation in splints or in casts involves the danger of pressure sores.

This brief review of the clinical physiology of athetosis makes it appear probable that the syndrome does not depend upon the release and exaggeration of predominantly local reflexes (as hemiplegic spasticity apparently does), but upon showers of impulses arising in higher centers as a response to afferent stimuli of many kinds. As the involuntary movements may take place in a hemiplegic extremity, they probably do not descend along the pyramidal tract. The results of treatment by section of extrapyramidal tracts and by other physiological means will be discussed.

Clinical Varieties of Athetosis and Dystonia

The physiological mechanism just described is seen in cases in which there is damage to certain portions of the basal ganglia: mesial and ventral portion of the thalamus, lenticular nucleus, corpus luysi, and occasionally red nucleus and the tracts leading to it from the cerebellum. The position of the lesion in relation to the pyramidal and extrapyramidal systems is shown schematically in Figure 1. Such injury may be produced in a number of ways.

The commonest etiology for the syndrome is birth injury. In eighteen out of thirty-eight cases observed at the Neurological Unit, there was a definite history of birth trauma, and in each case the infant was immediately noticed to be paralyzed. In two cases of the series, the birth was premature, and in one case, there was hemorrhagic disease, with onset of symptoms seven months, twelve years, and eight months later, respectively. Symptoms usually were retarded; in twelve cases they occurred between the ages of eight and twenty. In two of these the disease was familial; in ten no etiology was discovered.

Athetosis may also accompany infectious and degenerative diseases and injury. Hammond's first case [11] developed in the course of a hemiplegia following pneumonia, and instances have been reported in the course of encephalitis, multiple sclerosis, and injury. Five such cases happen to be included in the present series. Athetosis (or paralysis agitans) as the result of a tumor is extremely rare. A "hemiballism" may, however, occur following metastasis to the body of Luys.

Athetosis was included in Gould and Pyle's "Dictionary of Curiosities

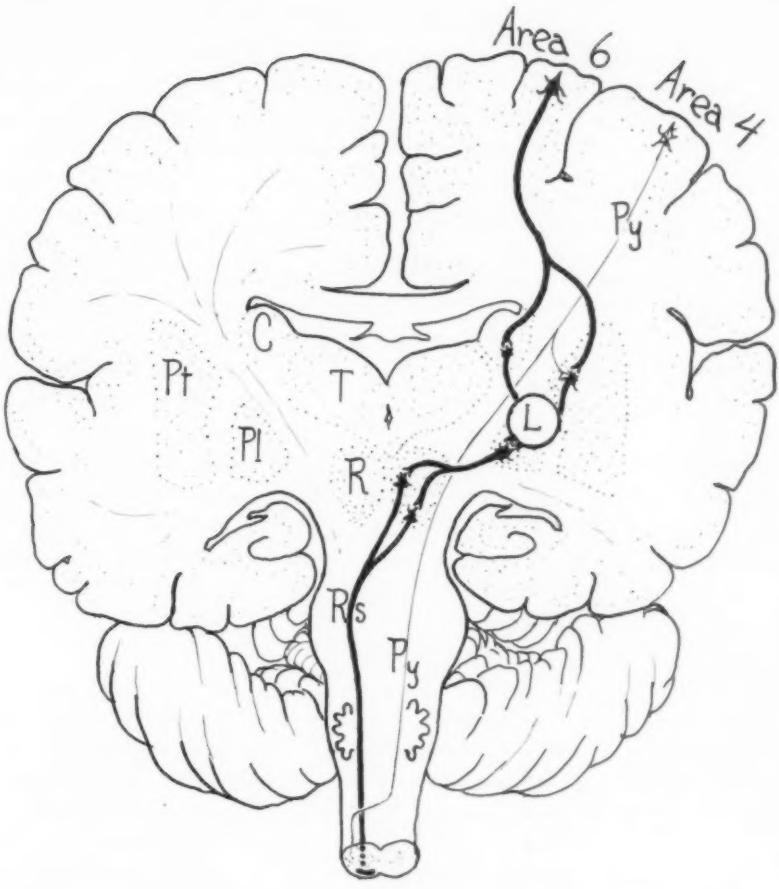

FIG. 1

Diagram of the extrapyramidal chain of neurons (heaviest lines) and the usual site of the lesion in cases of athetosis and dystonia, in their relation to other structures. *C* = caudate nucleus; *L* = lesion; *Pl* = globus pallidus; *Pt* = putamen; *Py* = pyramidal tract; *R* = reticular substance; *Rs* = reticulospinal tracts; *T* = thalamus.

of Medicine" (1898). It is, however, by no means a rare disease. No reliable statistics are available, but the incidence of birth injuries in general is probably greater than that of poliomyelitis, and, roughly estimated, between 10 and 25 per cent. of the cases of birth injury show athetosis or dystonia. The dry statistics and bare physiological description of cases gives no adequate picture of the misery which the disease produces. In its severer forms it is usually a bar not only to self-support, but also to almost every form of social intercourse and enjoyment. The patients, many of whom are intelligent, are often taken to be mentally deficient or are confined to institutions for the feeble-minded for lack of other possible disposition. There are few diseases which are more distressing, and advances in treatment are urgently needed.

TREATMENT OF ATHETOSIS

Athetosis has in the past been considered a neurosis, and torticollis is still so considered by many. There is no doubt that the abnormal movements are usually greatly increased by emotional strain and excitement, and patients are often improved by the cultivation of serenity and resignation, for example, by psychoanalysis.[21]

Muscle Training

Actual muscle training and special exercises have been of benefit in certain cases. Exactly what principles are involved, and what cases may expect substantial relief, is by no means as clear as is the situation in regard to poliomyelitis. Improvement of strength or nutrition of muscles is seldom necessary. What is needed is relaxation, and this is difficult to teach. The methods to be employed and the qualitative results obtainable are outlined in the publications of Carlson[6] and of Phelps.[29] Unfortunately, no statistical analysis of a series of cases has yet been presented. Such measures are always worth trying, and, if they are successful, nothing more drastic need be considered, but a considerable proportion of even the willing and intelligent patients fail to obtain much benefit after years of patient effort in specialized clinics.

Drug Therapy

Drug therapy has been entirely unsuccessful in the past. Recently, West[41] in England and Burman[5] in the United States have reported interesting results with curare, which produces a relaxation of hemiplegic spasticity and athetoid movements lasting sometimes several days. The treatment is not yet on a practical basis. From attempts to repeat their work at this Clinic, it appears that proper preparations are difficult to obtain, the therapeutic index is low, and the effects are evanescent. It is possible that more will be accomplished in the future.

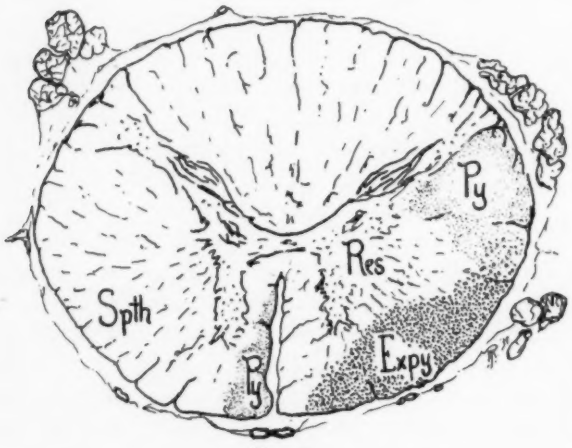

FIG. 2

Diagram of the principal pathways in the cervical cord, drawn from an actual specimen of degeneration of the pyramidal tract, modified according to cases published by Obersteiner[26] and by Thomas.[40] *Expy* = extrapyramidal tracts (coarse stipple); *Py* = pyramidal tract (fine stipple); *Res* = respiratory tract; *Spth* = spinothalamic tract.

Operative Orthopaedic Treatment

On the whole, little is accomplished for the athetoid syndrome by peripheral opera-

tions on muscles or nerves. Posterior-root section and operations of the Stoffel type are definitely contra-indicated. Stabilization of the ankle or tenotomy of the Achilles tendon is sometimes of benefit; either operation should, however, be deferred until neurosurgical procedures have been carried out, if any are contemplated. External fixation of the affected extremities is seldom practicable.

Neurosurgical Treatment

The first successful operation for athetosis was reported by Horsley [17] in 1909. In a case of athetosis of one arm, he resected the corresponding motor cortex, with relief of the abnormal movements, which were replaced by an incomplete paralysis. Successful operations of this type have been reported by Anschütz,[1] Payr,[28] Nasaroff,[25] Bucy and his collaborators,[2, 3] Sachs,[37] Klemme,[20] and others; unsuccessful ones have been recorded by Spiller, Frazier, and Van Kaathoven,[38] Foerster,[8] Naffziger,[24] and others. Some unsuccessful cases have not been reported; in one a fatality occurred. Bucy, who has given much thought to the subject, recommends that the operation be performed only if one extremity alone is affected and if it is already useless. The cortical resection should be a generous one.

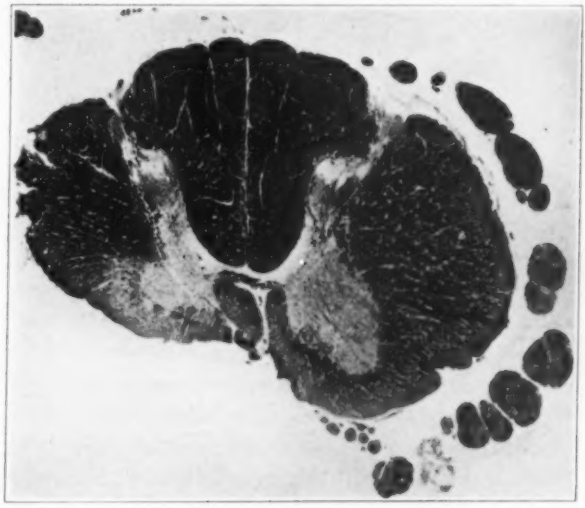

FIG. 3

Degeneration of the anterior column of the cervical cord following a thrombosis of a branch of the anterior spinal artery fifteen years previously. The patient had no weakness of the legs, and neurological examination of them was negative.

Another type of operation is that introduced at the Neurological Unit in 1931, consisting of a section of the extrapyramidal pathways in the cervical cord. The extrapyramidal tracts are by definition those long descending systems which degenerate following lesions of the upper cord, but not following cortical or capsular lesions. The most important of these are the vestibulospinal, the reticulospinal, and, perhaps, the rubrospinal bundles, which lie in the anterior column of the spinal cord, between the anterior roots and the mid-line (Fig. 2). The destruction of this region in chordotomies for pain does not produce a motor deficit (Hyndman [18]), and spontaneous lesions of it result in inconspicuous symptoms (Fig. 3).

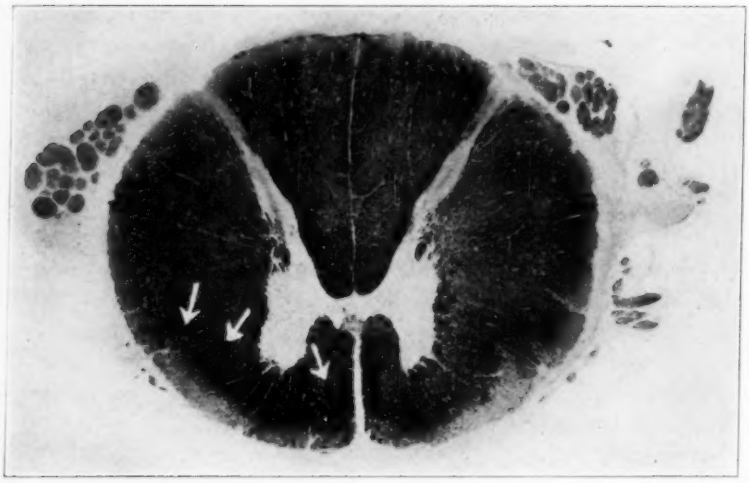

FIG. 4

Degeneration of the anterior column (arrows) following cauterization for athetosis. The patient died of pneumonia two weeks after operation. (Marchi stain.)

Technical details of the operation have been published elsewhere.[31, 32] As the operation is done at present, a laminectomy of the second and third cervical vertebrae is performed, well out to the pedicles on the side to be dealt with. The dura is opened opposite the posterior roots. A slip of the dentate ligament is severed and used to rotate the cord, so as to expose the anterior roots of the second cervical vertebra. A pointed ophthalmic cautery, heated to 80 degrees, is laid against the anterior column, mesial to the anterior roots, for forty-five seconds. Only one side should be operated upon at one time.

If torticollis is a distressing feature—as it is in many cases—a section of the first three anterior roots and both spinal accessories (either in the posterior fossa or in the neck) may be performed at the same operation. This is the standard Foerster-Dandy operation for torticollis.[7] A more extensive laminectomy (of the first, second, and third cervical vertebrae) is involved, which increases the risk of the operation.

The operation is obviously not without danger. There have been four postoperative fatalities in the present series of fifty operations in thirty-eight cases. The fatal cases were numbers 3, 5, 8, and 33 in the series. In the first three of them, a bilateral section of the anterior column and of the anterior roots was performed at a single operation. This is certainly unwise, and should never be attempted. A Drinker respirator should be available, and a transfusion should be given routinely. Tidal drainage of the bladder is often necessary for a few days.[23] The development of the progressive confusional syndrome—loss of memory and delirium, due to inadequate supply of oxygen—should be watched for.[34] With these precautions, only one death has occurred in the last twenty-three cases; this was from pneumonia two weeks after operation.

This operation has also been employed by others. Oldberg [27] reports eight cases; Machansky,[22] six; Toennies,[39] two. There are, therefore, on record a larger series of cases treated by this operation than by the older Horsley type of operation.

RESULTS OF CHORDOTOMY FOR ATHETOSIS

Among surviving patients there has been a high proportion of improvement, especially in the later part of the series. Only one patient considers herself worse as a result of the operation, and her opinion is not borne out by a study of moving pictures taken before and after the operation.

The degree of improvement is extremely difficult to evaluate. In four cases, the patients have become able to work, when this had previously been impossible. No such happy result is to be expected in the severe bilateral cases with paralysis. With these patients, the ability to lie still, to sit in a chair, or to use one hand in eating or to call an attendant, may be a precious acquisition, and improvement of this grade occurs in over half of the cases. Patients who are ambulatory are usually enabled to go about the street with less embarrassment and distress. Dystonic movements of the tongue are, of course, not affected, but speech is often improved through better control of respiration.

Obviously, no increase in strength is to be expected from such a procedure; indeed, the total strength of the affected extremities may be slightly decreased. This is more than compensated for by improved control. If there is an alternating tremor in addition to the athetosis, it is not affected. A slight contralateral hypalgesia often occurs. Progression of the disease and involvement of other cerebral structures may, of course, occur in spite of the operation, especially in the familial cases and in those without obvious etiology.

The partial relief of movements often affords an improved opportunity for retraining and psychotherapeutic measures and a firmer basis for orthopaedic operations. Naturally, any advances made should be immediately followed up by other appropriate forms of treatment.

SUMMARY

1. A sharp distinction should be made between the various types of "spasticity", as each requires its own particular type of treatment.

2. The chief types of "spasticity" are hemiplegia (including monoplegia and diplegia), paralysis agitans and the associated rigidity, and the athetoid-dystonic group.

3. Of neurosurgical operations for athetosis, cortical excision may be considered in cases in which one arm alone is affected and is already useless.

4. Section of the extrapyramidal tracts in the spinal cord is a procedure now wisely used for athetosis. It affords moderate to satisfactory relief of abnormal movements in the majority of cases. It can be combined with the Foerster-Dandy operation for torticollis when indicated.

The dangers of the operation have been greatly diminished by the use of proper precautions.

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RECURRENT LUXATION OF THE ULNAR NERVE BY CONGENITAL POSTERIOR POSITION OF THE MEDIAL EPICONDYLE OF THE HUMERUS

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There is a form of habitual luxation of the ulnar nerve which is conditioned by a congenital anatomical anomaly of the lower end of the humerus. The medial epicondyle is placed posteriorly, and the sometimes medially displaced tip of the olecranon is anterior to the medial epicondyle. The distance from the lateral epicondyle to the olecranon is greater than the distance from the olecranon to the medial epicondyle. The isosceles triangle which is formed by the two epicondyles and the olecranon process in elbow flexion of 90 degrees is absent, and the apex of the new triangle is reversed.

In acute flexion of the elbow, the olecranon is placed on the same level as the lateral epicondyle, the medial epicondyle being quite posterior to both. In extension of the elbow, the olecranon is on a line with the medial epicondyle, but the lateral epicondyle is proximal to this line. The distance from the olecranon to the lateral epicondyle is still greater than that from olecranon to the medial epicondyle.

The anomalous anatomical arrangement is bilateral and usually symmetrical. The authors have seen asymmetry in only two cases. It is apparently congenital, since it exists in equal degree in each elbow, and since there is no history of any preexisting disease or trauma affecting both elbows. The roentgenogram does not show this abnormal spatial relationship adequately.

The authors believe that this anomaly predisposes to recurrent luxation of the ulnar nerve. Slipping of the nerve out of its groove on flexion of the elbow is favored by the fact that the nerve lies nearer the summit of the medial epicondyle in flexion. Physiological valgus of the elbow is diminished on flexion, so that it becomes easier for the nerve to jump out of its groove. Pronation of the flexed forearm is said to favor luxation. The broadening of the inner shelf of the triceps muscle on flexion tends to push the nerve forward. These normal movements never in themselves produce a luxation of the nerve, but they favor the recurrence of luxation once it has been established. In the presence of the anomaly, the ulnar nerve must run a longer course and is, therefore, bow-stringed behind the medial epicondyle. Its tension is increased on flexion, and the nerve must luxate anteriorly to escape this increasing tension. The luxating nerve causes a fullness on the inner side of the medial epicondyle. On extension,

* Services of Leo Mayer, M.D., and Harry Sonnenschein, M.D.

the nerve slips back into its groove, since tension is released. If the nerve is bound in its groove for some reason and cannot luxate, an ulnar-nerve neuritis may develop much more quickly than if the nerve does luxate. This has been observed in two cases. In the presence of this anomaly, fixation of the nerve is the exception rather than the rule.

The incidence of recurrent luxation of the ulnar nerve in elbows in which the congenital anomaly is presumed to be absent is known. Subluxation of the nerve to the tip of the medial epicondyle is not infrequent, according to Cobb. Actual luxation is rare, and luxation with disabling symptoms is most unusual. In Cobb's series of 200 patients, whose elbows were investigated for abnormal mobility of the nerve, there were three with dislocation of the nerve on flexion of the elbow,—an incidence of 1.5 per cent. Haim found no cases of luxation of the nerve in 300 cases examined; Raymonenq observed no cases among 350 patients whom he examined; Drouard reported three out of 200 cases; Collinet discovered thirteen cases among 500 patients; and Momburg found the condition in twenty-three out of 116 cases.

The present authors examined the elbows of eighty patients in order to study the incidence of this congenital anomaly and the related secondary luxation of the ulnar nerve. The youngest patient was a female, seven months old; the oldest was a man of sixty-seven. The anomaly

FIG. 1

Photograph of the left elbow of a shoemaker, fifty-five years of age, who had noted pain on the inner side of this elbow while hammering and machining shoes. This pain is due both to an epicondylitis and to a recurrent luxation of the left ulnar nerve in the presence of the anomaly. It should be noted that the luxation was bilateral but symptomatic on the side of use, the patient being left-handed. The epicondyle and the olecranon are indicated by dots. It is difficult to show the spatial relationship adequately. It can be seen that the medial epicondyle is situated much more posteriorly than normal.

was present in eleven (14 per cent.); of these, there was no luxation of the ulnar nerve in three, luxation of the right ulnar nerve in two, luxation of the left ulnar nerve in three, and luxation of both ulnar nerves in three,—certainly an unusual incidence of association when comparison with the control figures is made. Since the anomaly of the elbow is bilateral, luxation may be bilateral. Luxation was usually slight, but sometimes the nerve luxated with a mild thud. The patient was usually unaware of this luxation. When the nerve did not luxate, it was noted that there was easy mobility of the nerve.

In seven of the eighty patients examined, the medial epicondyle was at the level of the tip of the olecranon. This is a borderline anomaly. There was noted a peculiar squaring of the flexed elbow in one of these patients, a colored woman, aged twenty-one. The right elbow of another patient showed luxation of the ulnar nerve on flexion of the elbow. In the other six patients there was no luxation, but in some there was increased mobility of the nerve. In both types—borderline and anomalous—a few cases demonstrated the greater ease with which the ulnar nerves were injured.

No instance of luxation of the ulnar nerve was found in any elbow in which the anatomical relations were considered normal.

It is believed by some that the carrying angle is diminished in this condition. The luxation seems to be more common in males, who normally have a lesser carrying angle than females. Haim thought that the carrying angle was 5 degrees less than normal in those cases in which the nerve luxated. A varus position of forearm to arm favors luxation of the nerve, owing to the shortened inner line of the forearm and arm, which creates disproportion between the length of the arm and the nerve. Schmidt reported a case of familial cubitus varus and other constitutional bone abnormalities in a man of twenty-three, in whom anterior luxation of the ulnar nerve took place on flexion of the elbow. An increase in the carrying angle or a valgus position of the elbow joint favors development of a delayed ulnar-nerve palsy.

The congenital anomaly of the elbow may have a familial transmission, as indicated by a study of two families. A mother, her daughter, and her son, showed the bilateral anomaly. The mother had no luxation of the ulnar nerve; the daughter showed a unilateral luxation; and the son had a frequent luxation of the left ulnar nerve and an occasional lesser luxation of the right ulnar nerve. A more interesting case is that of a printer, a man of forty-three, with bilateral intermittent ulnar-nerve palsy. Both elbows showed recurrent luxation of the ulnar nerve in the presence of the anomaly. The patient's daughter, a girl of twelve and one-half, had noted clawing of the fourth and fifth fingers of the left hand for two days. The ulnar nerve was fixed in its groove and did not luxate. The left elbow showed the very typical anomaly; the right exhibited the borderline anomaly, with no luxation of the nerve. Two other families were investigated, but each family had only one child, who did not show

the anomaly. The father of one family presented the congenital anomaly, with mild bilateral luxation of the ulnar nerve. The mother of the second family had the borderline type of anomaly, with no luxation of the ulnar nerve.

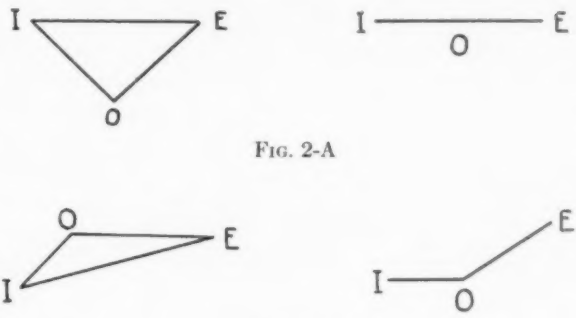

FIG. 2-A

FIG. 2-B

Diagrams illustrating position of the epicondyles of the humerus with reference to the olecranon process.

Fig. 2-A: The normal elbow in flexion and extension.

Fig. 2-B: The congenital anomaly of the elbow described in this paper. The medial epicondyle is placed posteriorly. The isosceles triangle is absent. In the flexed elbow, *EO* is greater than *IO*, *E* being the external or lateral * epicondyle, *O* the olecranon, and *I* the internal or medial * epicondyle. In the extended elbow, *I* and *O* are on the same line, but *E* is elevated.

No exact figures can be given as to length of time it may take before luxation of the ulnar nerve is noted in the presence of this anomaly. It may be noted early in life without trauma. The earliest age at which this luxation was present was six and one-half years. It is not surprising that severe luxation of the ulnar nerve may develop with or without neuritic symptoms, in view of the fact that the patient is compelled to flex and to extend the elbows many hundreds of times in a day. Our control statistics indicate that mild luxation, or a tendency to it, is frequently present when the congenital anomaly exists. If the ulnar nerve luxates to a lesser degree in the usual number of flexion and extension movements of the elbow, then it should luxate to a greater degree when the number of these flexion and extension movements is increased, and in fairly immediate connection with the beginning of such movements. The tendency to luxation is always bilateral, and severe luxation should develop on the side of great use or on the side of greater handedness. If repetition of flexion and extension is absent, the patient may or may not become aware of the luxation of the ulnar nerve. The friction neuritis, which is caused by the repeated luxations of the nerve, leads in time to the formation of a fusiform neuroma within the continuity of the nerve at the level of the epicondyle.

Preventive treatment is the avoidance of repeated flexion and extension movements of the elbow. This may mean change of occupation. If neuritic symptoms and signs are present, an anterior transposition of the ulnar nerve should be done. Osteotomy of the lower end of the humerus, to bring the medial epicondyle into a more anterior position, is not indicated.

The posterior placement of the medial epicondyle must be considered

* Throughout the text the terms "lateral" and "medial" instead of "external" and "internal" have been used.

to be due to either a lack of complete rotation of the upper extremity in very early embryonic life or a separate twist of the lower end of the humerus during that period. The anatomical evidence of Rutherford does indicate that there is a time when the capitellum is at a higher level than the trochlea. The persistence of such a condition into adult life is possible, and seems the feasible explanation for this anatomical anomaly of the elbow.

ILLUSTRATIVE CLINICAL CASE

J. A., male, forty years old, was first seen in April 1935, because of indefinite dull pain on the inner side of the left elbow and forearm. In October 1934, he had worked as a cutter of goods, hitting a die with a hammer several thousand times a day. He had had no trouble with the elbow before this job, which required these repeated flexion and extension motions.

On flexion of the left elbow, the ulnar nerve dislocated anterior to the medial epicondyle; it returned to its groove on extension. The tissues on the inner side of the elbow were painful, and each jumping of the nerve increased this pain. The nerve showed some thickening at the level of the epicondyle. There was definite hypaesthesia to pin prick and touch in the ulnar-nerve area of sensation. There were no motor changes. The carrying angle of the elbow was normal.

On May 23, 1935, anterior transposition of the left ulnar nerve was done (M. S. B.), together with neurolysis (or multiple longitudinal splitting of its sheath) at the point of the fusiform neuroma. Recovery was uneventful. The anatomical relationship between the epicondyles and the olecranon process was of the type described. This relationship was present in the normal right elbow, which showed no luxation of the ulnar nerve. This elbow had never been subjected to repeated flexion and extension movements. The patient is left-handed.

In December 1938, when last examined, the patient had no complaints referable to the left elbow. Sensation in the fingers was normal. The ulnar nerve could be palpated in an anterior position, and, on flexion, only slight crepitation was elicited in the postcondylar groove. The patient had chronic infectious arthritis of the hands, the wrists, and the knees.

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EXPERIMENTAL PRODUCTION OF SCOLIOSIS

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The exact mechanism by which scoliosis takes place, aside from that caused by obvious destructive lesions and developmental anomalies, is still an unsolved problem. In investigating the causative factors it is of prime importance to know the exact process of growth of the vertebrae. In a recent article by the writer,[1] it was demonstrated that growth in length of the vertebrae takes place at the epiphyseal cartilaginous plates at both ends of the bone, just as it does in the long bones.

It is well known that injury to the epiphyseal cartilaginous plates of a long bone will cause growth disturbances. Injury to a portion of the epiphyseal cartilaginous plate will cause an asymmetrical growth of a long bone with resultant deformity. It is a natural assumption that similar changes in the growth of the vertebrae will occur after injury to the epiphyseal cartilaginous plate, resulting in scoliosis or kyphosis.

In order to prove the correctness of this assumption, a series of experiments were planned in which the epiphyseal cartilaginous plates of the vertebrae of young dogs between the ages of two and three months were traumatized in varying degree.

In order to injure the epiphyseal cartilaginous plates, it was necessary to expose the bodies of the vertebrae through an abdominal incision and transabdominal approach. After the viscera had been walled off, the aorta and the vena cava were carefully retracted away from the bodies of the vertebrae. In order to see the epiphyseal cartilaginous plates clearly, it was necessary to incise the periosteum and the perichondrium and to deflect them from the ends of the bone. Since these plates in young dogs are scarcely one millimeter in width, considerable care is demanded in carrying out any localized destruction.

In four animals varying degrees of injury were inflicted on the epiphyseal cartilaginous plates. Following the injury, in each animal a deformity of the spine took place. This deformity varied with the severity of the injury to the epiphyseal cartilage and with the particular situation of the injured vertebrae. Figures 1-B, 1-C, 1-D, and 1-E show the gross appearance of the spines at the end of the observation period. Figure 1-A shows the normal spine of a dog of about the same age as the animals which were operated upon. The spine in Figure 1-B had an injury to the fifth and sixth vertebrae. The curvature is low and limited by the fixation of the pelvis. The specimens in Figures 1-C and 1-D show a much more marked curve, as the injured vertebrae were at a higher level and more amenable to the deforming influence. The specimen in Figure 1-E exhibits a slight lateral curve, but there is a considerable

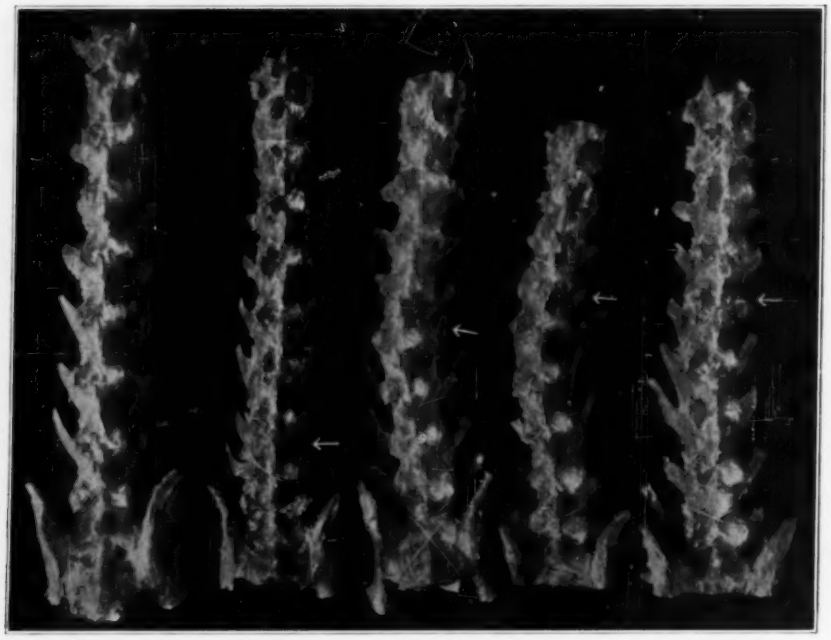

FIG. 1-A FIG. 1-B FIG. 1-C FIG. 1-D FIG. 1-E

Fig. 1-A: Normal spine of a dog. (Note that a dog has seven lumbar vertebrae.)
Fig. 1-B: Dog 3. Injury to the epiphyseal cartilaginous plate of the fifth lumbar vertebra. Slight scoliosis, due to fixation of the pelvis, is present.
Fig. 1-C: Dog 5. Injury to the distal epiphyseal cartilaginous plate of the third lumbar vertebra and of one side of both epiphyseal cartilaginous plates of the fourth lumbar vertebra. Marked scoliosis was produced.
Fig. 1-D: Dog 4. A hole was bored into the body of the second lumbar vertebra. The proximal epiphyseal cartilaginous plate of the third lumbar vertebra was injured on one side. There is a marked scoliosis.
Fig. 1-E: Dog 6. The proximal epiphyseal cartilaginous plate of the third lumbar vertebra was injured. Both epiphyseal cartilaginous plates of the fourth lumbar vertebra were injured toward one side and anteriorly. There is a slight scoliosis, but a more marked kyphosis is observed.

kyphosis. In this animal the injury was more toward the anterior part of the epiphyseal cartilaginous plate.

After having been preserved, the specimens were cut with a fine saw through the bodies in the frontal plane, as shown in Figures 2-A through 2-E. Close study shows the epiphyseal cartilaginous plate at each end of the bodies of the normal vertebrae (Fig. 2-A). It should be noted that the epiphyseal cartilaginous plate is not straight, but wave-like, so that a straight cut may not injure all the cells. Figures 2-B, 2-C, 2-D, and 2-E show the changes in the epiphyseal cartilaginous plate following the injury and corresponding differences in size and shape of the bodies of the vertebrae. The injured cells of the epiphyseal cartilage cease to grow, while the intact parts proliferate and cause increase in length of the body on that side, with a resulting curvature of the spine. A detailed description of the experiments will be given for study.

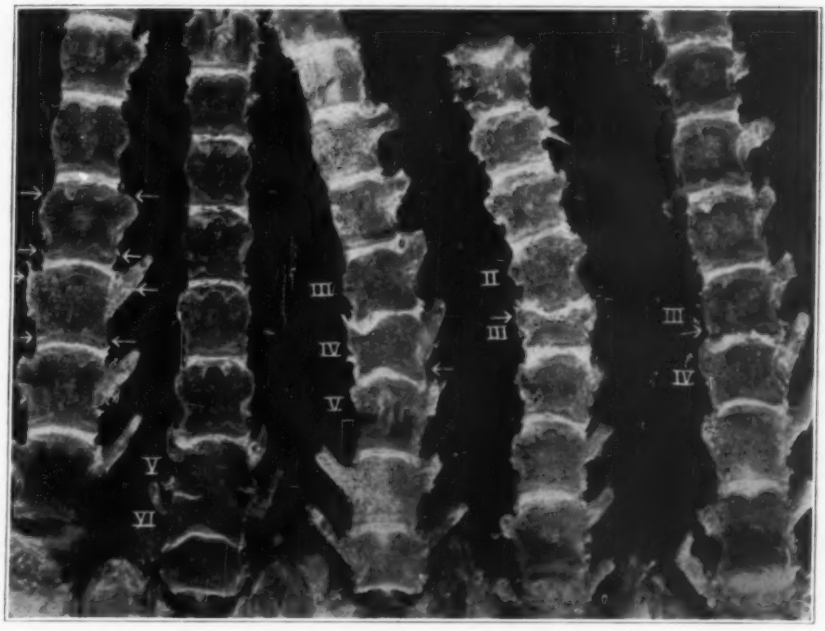

FIG. 2-A FIG. 2-B FIG. 2-C FIG. 2-D FIG. 2-E

Same spines as shown in Figs. 1-A through 1-E, except that the bodies have been sawed through in the frontal plane. The curves are reversed in turning the specimens over.

Fig. 2-A: Normal spine showing the normal wavy epiphyseal cartilaginous plates at both ends of the bodies of the vertebrae.

Fig. 2-B: Dog 3. Shows ossification of both epiphyseal cartilaginous plates of the fifth lumbar vertebra. There is partial fusion of the bodies of the fifth and sixth lumbar vertebrae, due to injury to the intervertebral disc. Slight scoliosis, due to external injury to the epiphyseal cartilaginous plates and fixation of the pelvis, is present.

Fig. 2-C: Dog 5. Shows the wedging of the fourth lumbar vertebra with persistence of a part of the epiphyseal cartilaginous plate on the convex side and marked scoliosis. The defect in the fifth lumbar vertebra is due to the fact that the saw cut entered the spinal canal.

Fig. 2-D: Dog 4. The proximal epiphyseal cartilaginous plate of the third lumbar vertebra was injured. The cut specimen shows a marked diminution in size, wedging, and scoliosis. The ossification of the proximal epiphyseal cartilaginous plate is seen on the concave side.

Fig. 2-E: Dog 6. The proximal epiphyseal cartilaginous plate of the third lumbar vertebra was injured. Both epiphyseal cartilaginous plates are seen, as the injury was on the anterior surface. Both epiphyseal cartilaginous plates of the fourth lumbar vertebra were injured. The proximal epiphyseal cartilaginous plate is ossified, while only a part of the distal plate shows ossification. Slight scoliosis is present, but there is more kyphosis, due to the greater injury to the anterior part of the plate.

EXPERIMENT 1. Dog 3. November 2, 1937.

Operation: The bodies of the fifth and sixth lumbar vertebrae were exposed through an abdominal incision. Markers were placed in the sixth vertebra for other studies. In so doing some injury to the plates was produced. Both epiphyseal cartilaginous plates of the fifth lumbar vertebra were injured on one side when a small, thin osteotome was forced into the substance of the epiphyseal cartilage.

Result: Examination on April 19, 1938, 168 days after operation, showed a marked growth disturbance of the bodies. Figures 1-B and 2-B reveal only a slight scoliosis,

as the involved vertebrae are close to the pelvis. The cut section shows the disturbance in growth. The fifth lumbar vertebra is wedge-shaped, and both epiphyseal cartilaginous plates are almost entirely ossified. Although no definite attempt was made to injure the plates of the sixth lumbar vertebra, the distal one is almost completely ossified, due to the injury caused by the insertion of the markers. The intervertebral disc was injured, and there is partial bony union between the bodies of the fifth and sixth lumbar vertebrae.

EXPERIMENT 2. Dog 4. November 19, 1937.

Operation: After exposure of the third lumbar vertebra, the proximal epiphyseal cartilaginous plate was injured on one side. A hole was bored into the second lumbar vertebra.

Result: Examination on March 5, 1938, 106 days after operation, showed a marked change in the shape of the spine. In Figure 1-D there is definite scoliosis, due to the greater growth on one side of the vertebral body. The cut specimen (Fig. 2-D) shows the ossification of a portion of the plate of the third lumbar vertebra on the concave side. This vertebra is much smaller than the adjoining ones. There is a slight change in shape of the second lumbar vertebra, into the body of which a hole was bored.

EXPERIMENT 3. Dog 5. November 19, 1937.

Operation: The third and fourth lumbar vertebrae were exposed. In the case of the third lumbar vertebra, only the distal epiphyseal cartilaginous plate was injured when a thin osteotome was pried into one side. Both plates of the fourth lumbar vertebra were injured in the same manner.

Result: Examination on March 5, 1938, 106 days after operation, revealed a marked scoliosis of the spine (Fig. 1-C). In Figure 2-C the change in shape of the fourth lumbar vertebra is well demonstrated. On the convex side the plate is present, while on the concave side it is absent. The third lumbar vertebra shows less disturbance, as only one epiphyseal cartilaginous plate was injured. The peculiar form of the fifth lumbar vertebra is due to the fact that the saw cut entered the spinal canal.

EXPERIMENT 4. Dog 6. November 22, 1937.

Operation: The proximal epiphyseal cartilaginous plate of the third lumbar vertebra was injured, while both epiphyseal cartilaginous plates of the fourth lumbar vertebra were injured by the insertion of a thin osteotome.

Result: Examination on May 27, 1938, 186 days after operation, revealed a moderate scoliosis (Fig. 1-E), which is not so marked as that shown in Figures 1-C and 1-D. The lateral view of this spine disclosed a considerable kyphosis. This was due to the fact that the injury to the plate was more anterior than lateral. The cut specimen (Fig. 2-E) shows the persistence of the injured epiphyseal cartilaginous plate of the third lumbar vertebra at the level of the cut surface. The proximal epiphyseal cartilaginous plate of the fourth lumbar vertebra is completely ossified, while the distal plate is partially ossified. The lateral view in this case would have shown wedging from the posterior to the anterior aspect.

COMMENTS

The growth of the body of a vertebra depends upon the integrity of the epiphyseal cartilaginous plate. This plate is sensitive to injury to its cells just as is the plate in the case of a long bone. The resultant disturbance in growth is directly in proportion to the degree of injury. Injury to a part of the plate will cause an asymmetrical growth of the body, manifested by irregularity in the shape of the vertebra and the development of a scoliosis. If the anterior part of the plate is injured, a kyphosis will occur, because of a greater growth on the posterior aspect of the body.

In the case of a long bone, an injury to the blood supply of the epiphys-

eal cartilaginous plate will cause a disturbance in growth of the plate. Although no specific experiments were performed on the vertebrae for this purpose, it was noticed in some experiments that changes took place in the epiphyseal cartilaginous plates and in the size of the bodies that were merely exposed without direct injury to the cells. Also, changes took place in the epiphyseal cartilaginous plates adjoining the injured plates. It is believed that these changes were due to the disturbance in the blood supply to these epiphyseal cartilaginous plates.

These experimental observations have brought out certain facts that may have an important bearing on the cause of curvature of the spine. It is also possible that they may be utilized in the treatment of certain lesions of the spine. Although Schmorl's work has thrown some doubt on the existence of a true epiphyseal cartilaginous plate in man, the author feels that growth of the bodies of the vertebrae in man takes place in a manner similar to that in animals. The relatively slow and small amount of growth in man over a long period of time demands a less active and less highly differentiated cartilaginous plate than does the faster growth of the long bones. If we accept this conception, then we could possibly treat curvature of the spine from hemivertebrae and other anomalies of the lumbar vertebrae by injuring the cartilaginous plates of the adjoining vertebrae on the convex side of the curve. This hindering of growth would tend to compensate the defect and to prevent deformity.

In paralytic scoliosis there are a number of forces that determine the type of curve. Besides the paralysis, with its distorting tension, there are disturbances in growth of the bodies, abnormal pressure forces, and circulatory disturbances. In the lumbar region it is possible that one could set up counter forces by producing growth disturbances in the vertebrae. The bodies of the vertebrae could be fused, if desired, by bone grafts or by throwing up sections of bone from the bodies. This was done in some experiments to be reported later. Whether this procedure would have sufficient advantage over spine fusion to warrant the additional risk and the greater technical difficulties would have to be considered. Of course, interference with the thoracic vertebrae, although possible, could hardly be put on a practical basis.

Fusion of the spinous processes and the bodies, when done early, may have a practical application in the lumbar region. Rotation could be prevented, and, if the bodies could not rotate, then the lateral bending should likewise be prevented. These suggestions leave an interesting field for further investigation.

Vertebral epiphysitis also presents some interesting speculative problems. The exact cause of this deformity is unknown. The wedging of vertebrae with lesser growth in front may be due to circulatory disturbance, localized disturbance in growth, or abnormal pressure forces. Because this deformity is mostly in the thoracic region, attack through the thoracic cage is not practical. If the posterior parts of the vertebrae could be injured, one would expect a diminution of the deformity. Spine

fusion, a much easier procedure, may have the same effect and may be just as efficient in preventing and in correcting kyphosis.

SUMMARY

Scoliosis can be produced in a dog by an injury to the epiphyseal cartilaginous plate on one side of the body of a vertebra.

It is possible that asymmetrical injury of the epiphyseal cartilaginous plate as a corrective procedure for deformities of the spine may be successfully utilized clinically. Hemivertebrae and other anomalies, growth disturbances, scoliosis, and epiphysitis may be amenable to this method in suitable cases in which the lumbar vertebrae are involved.

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PRIMARY PYOGENIC OSTEOMYELITIS OF THE ARTICULAR PROCESSES OF THE VERTEBRAE

Report of an Unusual Case

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The occurrence of pyogenic osteomyelitis of the vertebral column is considered to be relatively rare when compared with the incidence of the same disease in the other bones of the body, especially in the long bones. However, when we consider the milder and more benign types, as well as the better recognized acute types, and make allowance for the many unrecognized cases, it will be found that the condition is not so very rare.

The usual conception of osteomyelitis of the spine is that of a severe acute inflammation, often with cord involvement and nerve complications. The recent progress made in roentgenographic technique and diagnosis has brought to light many cases of the milder and more chronic variety, referred to as the "benign form" [21, 30, 33] with or without abscess formation. Clinically these may be mistaken for other conditions giving pain in the back, such as rheumatism, arthritis, referred visceral pain, etc. In the early stages of inflammation there are no definite roentgenographic findings, but soon alterations in the bone structure become manifest.

The earliest report on osteomyelitis of the spine was made by Lannelongue [19] in 1879. Subsequent reports on the subject appeared by Hahn [9] in 1895 and 1899. Of a series of 661 cases compiled by him from two European clinics, small and irregular bones were involved in fifty-one and the vertebrae in only one.

At the Mount Sinai Hospital in New York City, an incidence of 1.5 per cent. of osteomyelitis of the spine is reported [33] in a series of osteomyelitis of all bones. Kulowski [17] reports 3.94 per cent. of osteomyelitis of the spine in a series of 1500 cases of pyogenic osteomyelitis of bones from the University Hospitals, Iowa City. In a series of 193 cases of osteomyelitis of all bones admitted to the American University Hospital, Beirut, Syria, there was one case in which the fourth and fifth lumbar vertebrae were involved, and a second case of possible involvement of the sacrum in a patient who had numerous foci of the disease in several other bones. The case reported in this article is not included in the series mentioned.

DISTRIBUTION OF THE DISEASE IN THE DIFFERENT PARTS OF THE VERTEBRAE

Conflicting reports about the distribution of the disease in the vertebrae have appeared in the literature. It seems possible to conclude, however, that in general the bodies are more commonly involved in the cervical region, and the arches and processes in the thoracolumbar region.[14, 17, 22]

FIG. 1

December 3, 1931. There is bone dissolution at the base and body of the right inferior articular process of the second lumbar vertebra. The articular portion is still preserved. A thin plate, representing the medial side of the articular process, is still seen. There is uniform dissolution of the right upper articular process of the third lumbar vertebra. The ring-shaped formation represents the product of dissolution deposited in the adjacent soft tissues.

Of the 102 cases reviewed by Kulowski, sixty were from the University Hospitals, Iowa City, and forty-two were obtained by questionnaire. Of the first group, the bodies were involved in fifty-three cases and the processes in six. In one case both bodies and processes were involved. Of the second group, the bodies of the vertebrae were involved in thirty-one; the processes, in seven; and in four they were combined. These figures show a constant predilection of the disease for the bodies rather than for the processes. In this series the processes were involved as follows: In the first group, two cases were in the thoracic region, with involvement of the laminae. In the lumbar region the transverse processes were involved in two cases, the lamina in one case, and the spinous process in one case. In the second group the transverse processes were involved in five cases; the spinous process in one; and the lamina in one. Knaggs [15] refers to a case of acute osteomyelitis localized to the tip of a spinous process which was necrosed and removed as such. In this case the disease evidently affected the secondary epiphysis of that process and seemed to have been limited to it.

In the arches, according to Donati (quoted by Wilensky and others), the spinous processes are most commonly affected, the articular processes next, and the transverse processes least frequently. Although of rare occurrence, inflammation of the bodies may extend to the arches and their processes. The articular processes may thus be involved by extension. In reports on the different types of suppurative involvement of the various regions of the spine and of the parts of the individual vertebra, extension into the articular processes is mentioned as a possibility, but there is no reference, in the literature at our disposal, to primary involvement of the articular processes. The following case, referred by Dr. M. Nassar of our Surgical Staff, seems, to the best of our information, to be the first case recorded.

CASE REPORT

B. A., female, twenty-six years old, single, was seen on February 18, 1938, complaining of slight pain in the back and a discharging sinus of three months' duration. There was nothing significant in her family and social history. She did not smoke or drink, and denied any venereal disease. There was no history of malignant growths or tuberculosis in the family.

In the summer of 1931 the patient had had a furuncle on the dorsal aspect of the left elbow. After two weeks' treatment with ointments and compresses, surgical intervention became necessary. On the second or third day after lancing, the patient had a severe, sharp pain in the lumbar region, just to the right of the mid-line. There was a slight febrile reaction. The urine was normal, and a mild leukocytosis was observed. Ten days later the patient was discharged. The pain in the back was ameliorated, but its cause had not been ascertained. The pain recurred at irregular intervals of about two months, lasting a few days each time. A sense of fullness was experienced in the mid-lumbar region on the right side.

The first roentgenographic examination, made elsewhere on December 3, 1931, was reported negative. Other roentgenographic examinations were made at frequent in-

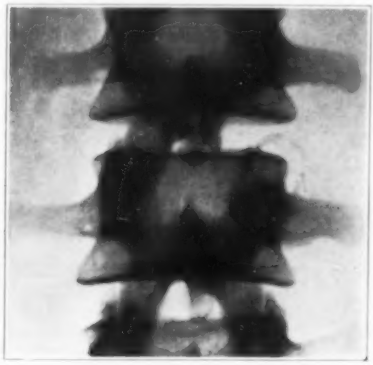

FIG. 2

April 18, 1932. Slight changes visible since last examination.

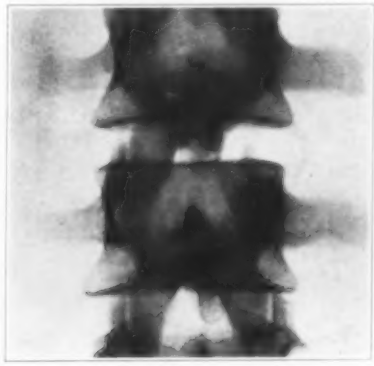

FIG. 3

September 8, 1933. Further osteolytic changes and discontinuity of annular shadow.

FIG. 4

April 10, 1935. Disappearance of annular shadow. Remaining part of articular process seen as a sequestrum.

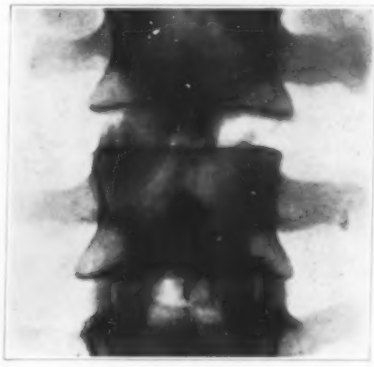

FIG. 5

September 30, 1937. Last stage of sequestration of the articular process.

tervals, but the true nature of the process was not understood, and finally a clinical diagnosis of tuberculosis was made, but never confirmed. In November 1937, during a recrudescence of the pain, antiphlogistin was applied over the painful site, and in a few days a localized swelling formed. Aspiration revealed the presence of pus from which staphylococci were cultured, and an operation was decided on. Two surgical explorations were made,—one in November 1937 and the other in January 1938. The abscess was opened, resulting in the formation of a sinus. Roentgenograms taken after the injection of lipiodol into the sinus tract failed to show any communication with the vertebral bodies. At the end of January 1938 a small sequestrum was extruded from the sinus; the discharge gradually decreased; and the sinus closed in about four weeks. The patient consulted us for the first time on February 18, 1938, just prior to the closure of the sinus.

Examination on that date showed the patient to be in good health. She had no disability whatever, and no pain on motion was experienced. Spinal mobility was normal. Just to the right of the mid-line there was a deep, thick scar from the two previous operations, extending from the lower thoracic to the lower lumbar regions. There was no tenderness on percussion (direct or indirect) or on palpation. Roentgenograms taken on that day showed absence of the right inferior articular process of the second lumbar vertebra, with destruction of the larger portion of the corresponding upper process of the third vertebra. Destruction was sharply confined to the parts mentioned and did not extend into the pedicles. There was no bone reaction. The bodies of the vertebrae and the intervening spaces were intact. No sequestra were visible.

On December 3, 1938, the patient was seen again and was in excellent health. She engaged actively and vigorously in all kinds of sports, including skiing, tennis, swimming, and gymnastics. Physical examination revealed no local findings other than the scar previously described. A roentgenographic recheck showed no change in the condition of the bone as compared with the examination on February 18, 1938.

The accompanying illustrations, selected from a large collection of the patient's films, taken at different places and times during the seven years of her illness, show the various stages in the progress of the disease. Bone dissolution continued steadily until the two articular processes had practically completely disappeared. It was after the examination of September 1937 that an abscess was formed. Operative attempts to scrape the bone were unsuccessful. At that time, iodized oil was injected into the sinus, but no communication with the vertebral bodies was demonstrated.

Figures 6-A through 6-D show the condition on February 18, 1938. On reexamination on December 3, 1938, the condition was essentially unchanged.

DISCUSSION

Although this case is quite unusual, it does fit in many ways into the group of pyogenic osteomyelitic bone infections. The disease in the bone is evidently etiologically connected with the skin lesion,—the furuncle on the elbow. The process is of long duration, extending over a period of seven years, and the roentgenograms demonstrate the different stages of the disease. It is noteworthy that there has been no bone reaction and no repair, as is usual in this location.[14, 31, 33] Once formed, the sequestrum kept up a continuous though slight discharge of pus, which ceased with the extrusion of the sequestrum. The disease has been arrested at this

FIG. 6-A

FIG. 6-B

February 18, 1938. Bodies, pedicles, and arches of the vertebrae are intact. (Residue of lipiodol at the right of arrow in Fig. 6-B)

FIG. 6-C

February 18, 1938. Right inferior articular process of second lumbar vertebra and right superior process of third lumbar vertebra are not visible (oblique view).

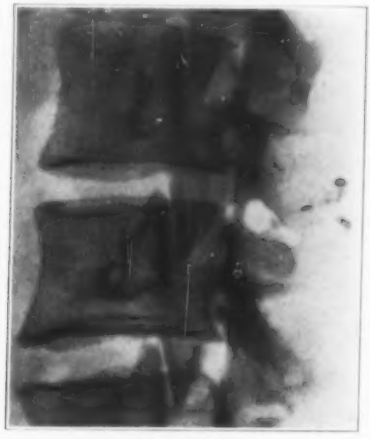

FIG. 6-D

February 18, 1938. Normal articular processes and joints as seen in the oblique view.

stage, and, judging from the previous course and the present condition, it seems improbable that any further changes will take place.

It is of significance that the loss of the articular processes and the consequent disappearance of the joint has not incapacitated the patient. This stands in marked contrast to the results of rheumatic or other inflammatory conditions ending ultimately in an ankylosis with corresponding and proportionate stiffness and disability.

This case is of further interest from the point of view of anatomical and developmental considerations. Osteomyelitis in the young occurs before ossification is complete, the disease starting at the locations of active growth. Ossification of the three primary centers of a vertebra occurs too early in life to have any bearing in this case. There are, however, five secondary centers in a vertebra, which appear at the age of sixteen and are completely fused by the twenty-fifth year of life. These secondary centers are found at the tips of the transverse and spinous processes, as well as at the upper and lower surfaces of the bodies of the vertebrae. The lumbar vertebrae have two additional epiphyses for the mammillary processes. The vertebral articular processes develop as outgrowths from the center of ossification for the arch on either side. The existence of secondary ossification centers at the tips of the articular processes is not recognized in standard books of anatomy and embryology,[1, 8, 12, 13] although McMurrich (quoted by Hipps [10] and by Mitchell [24]) states that secondary centers of ossification appear at puberty in the cartilage at the tips of the articular processes. These epiphyses remain separate until growth is complete, uniting with the primary epiphysis at the same period in which the other secondary vertebral epiphyses unite.

This has been the subject of discussion in a number of recent reports in connection with an anomalous condition seen at the tips of the articular processes,—the presence of a horizontal or oblique linear cleft or fissure, with complete or incomplete separation through the tips of the processes. This is usually observed at the inferior articular processes of the second or third lumbar vertebra, and is usually bilateral.

Rendich and Westing [28] consider these to be accessory articular processes, while others [2, 10, 11, 27] believe them to be due to the presence of ununited secondary epiphyses, which ordinarily appear and ossify at the same time as the other secondary epiphyses.

What contributory part this condition may have in the development of the inflammatory process in the case described is difficult to evaluate. It is possible that the initial focus started at the site of the ununited epiphysis of the mammillary process of the third lumbar vertebra and extended into the entire articular process with which it is intimately connected and practically fused. On the other hand, this case does not seem to be one of "accessory articular processes" or of secondary epiphyses of the articular processes. Figure 1 shows no evidence of a cleft or separation in the articular processes in question. Either would fail to explain the simultaneous involvement of the superjacent articular process, the joint space as such having been more or less preserved until the bones forming it on either side were destroyed. Had the inflammation started in either of the articular processes in question and crossed to the other through the joint space, the appearance of the latter would have been different. The condition thus seems to be one of *primary* involvement of the articular processes.

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OPERATION FOR CORRECTION OF HAMMER-TOE

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The standard operative technique in general use at the present time for the correction of hammer-toe deformity consists of dorsal wedge resection of the proximal interphalangeal joint. Although this operative procedure brings relief in some cases, it can satisfy neither a discriminating patient nor a surgeon whose aim is to establish as complete restoration of normal functional and anatomical relations as possible.

There are several varieties of hammer-toe. The most common is the plantar-flexion contracture at the proximal interphalangeal joint. This may be combined with dorsiflexion contracture of the metatarsophalangeal joint, or in some cases motion in this joint may remain unrestricted. In addition, the distal interphalangeal joint likewise may develop a plantar-flexion contracture. Less frequently this plantar-flexion contracture of the distal phalanx is the only component of the hammer-toe, the other toe joints remaining practically normal.

Occasionally the distal phalanx adapts itself to the attitude of dorsiflexion in cases where the deformity consists of plantar-flexion contracture at the proximal interphalangeal joint with or without the dorsiflexion contraction at the metatarsophalangeal joint.

At first the deformity remains reducible, but after a time the capsule of the joints, the tendons, and even the subcutaneous tissues and skin contract, and the deformity becomes fixed.

As long as soft-tissue contractures are the main changes found in the hammer-toe deformity, it seems logical to limit surgery to the release of these contractures, avoiding resection of the bones. The ideal correction of the flexion contracture of the knee joint is the capsuloplasty, releasing the contracted parts. The wedge osteotomy through the knee joint is not advisable, for, although it reestablishes the alignment, it sacrifices the motion.

DESCRIPTION OF THE OPERATION

The operative procedure which we have been using for the past several years is as follows:

Under local block anaesthesia, a hockey-stick skin incision is made on the dorsum of the toe, somewhat laterally from the middle line, care being taken to spare the dorsal digital nerves and blood vessels. No tourniquet is used. The flattened tendinous expansion of the extensors, which is intimately interwoven with the joint capsule, is exposed. A tongue-shaped

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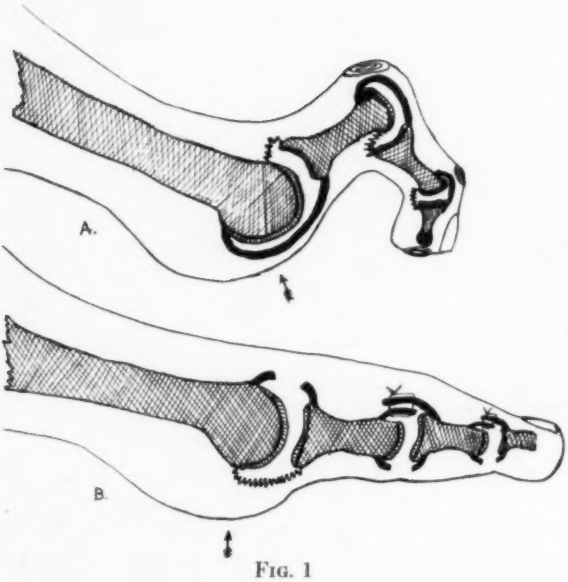

FIG. 1

FIG. 1

Schematic drawings of the hammer-toe before (*A*) and after (*B*) the operation. The corrugated line represents the part of the joint capsule which has become contracted; the heavy black line, the capsule which has been put on stretch. The articular cartilage is shown by a double line with cross striation. Note that in the hammer-toe weight is borne over the cartilaginous part of the metatarsal head through the overstretched plantar capsule (arrow). Moreover, the weight is borne over the skin on the anterior part of the toe, where the skin is comparatively thin and without the fat padding which is found over the ball of the toe (shown by arrow in *B*). This is the reason that tenderness is often found in this region. Concentric lines represent the corns. Solid black areas in the phalanges show the parts of the bone which sometimes must be shaved off. Note the dorsal subluxation of the basal phalanx in the metatarsophalangeal joint and the plantar subluxation of the middle phalanx at the proximal interphalangeal joint.

FIG. 2-A

FIG. 2-B

Case 17. Woman, fifty-two years old, with bilateral multiple hammer-toe deformity and very tender corns. The right third and fourth and the left second, third, and fourth toes were operated upon on March 18, 1935. The deformity of the left second and third toes and the right third toe consisted mainly of plantar-flexion contracture of the distal phalanx. An operation for the corns on both fifth toes was also performed.

Fig. 2-A: Before operation, March 18, 1935. The nail of the left third toe cannot be seen as the weight was borne on it.

Fig. 2-B: After operation, May 2, 1935. Note satisfactory correction of the toes and disappearance of corns (also over the fifth toes).

Arrows show the long axis of the phalanges and also the corns.

flap, with the base attached to the middle phalanx, is outlined over the dorsum of the proximal interphalangeal joint, and the latter is exposed. A small dorsal prominence over the dorsum of the head of the proximal phalanx sometimes requires shaving off. A subcutaneous plantar tenotomy and capsulotomy of about 180 degrees—that is, from one collateral ligament to another—are performed. The tenotome is held close to the bone avoiding digital blood vessels and nerves. It is important to obtain complete release and even slight overcorrection of the plantar-flexion contracture. The tongue-shaped flap is then resutured with reduplication (as in a double-breasted coat) to the proximal stump of the tendon and capsule by means of one or two fine chromic mattress stitches. If dorsiflexion contracture is present at the metatarsophalangeal joint, it is also released subcutaneously with a tenotomy knife in the thorough manner already described. Extreme gentleness during the operation and meticulous care of circulation should be exercised.

FIG. 3-A
March 27, 1935

FIG. 3-B
May 7, 1936

Case 7. Boy, twenty years old, with spastic paralysis, causing deformity of the left second toe. Plantar-flexion contracture at the proximal interphalangeal joint without any changes in the metatarsophalangeal joint. Four years after operation some motion was present at the proximal interphalangeal joint.

The toe is splinted with well-fitted, loosely strapped whale bones. Immobilization should be thoroughly carried out for about three or four weeks after the operation. The patient may be permitted to walk a few days after the operation, wearing shoes cut out over the toes.

In cases of long standing, there may be marked shortening of the dorsal part of the capsule and the extensor tendon at the metatarsophalangeal joint, often combined with dorsal subluxation of the basal phalanx.

The attempt to release this contracture by the subcutaneous method is not always successful. Forcing the basal phalanx into plantar flexion may result in a further dorsal subluxation of its base, similar to the posterior subluxation of the head of the tibia, which occurs as the result of stretch-

FIG. 4-A
November 26, 1934

FIG. 4-B
March 30, 1935

Case 6. Girl, fifteen years of age, with deformity of right third toe following anterior poliomyelitis. Plantar-flexion contracture of both interphalangeal joints with rotation and deviation of the tip of the toe toward the tibial side. An operation was performed four years ago. Pressure necrosis from the cast (because of the patient's walking with a plaster cast against advice) resulted in loss of the toe nail, but, in spite of that, good correction was obtained. Motion in the interphalangeal joints was lost.

ing of the flexion contracture at the knee. A small longitudinal incision is then made over the dorsum of the metatarsal head slightly away from the middle line. All the contracted structures are then divided transversely under the control of the eye. After that, if the procedure has been carried out properly, the toe deformity remains completely corrected without any external support.

In cases where plantar-flexion contracture at the distal interphalangeal joint is also present, a similar procedure is carried out over this joint. However, in some cases, we have felt justified in fusing the distal interphalangeal joint. This joint is really rudimentary in the human foot, and, as a matter of fact, in a considerable percentage of feet there is a congenital fusion of the middle and distal phalanges of the fifth toes. The fusion procedure is carried out by shaving off the articular cartilage (without bone resection) and performing the capsuloplasty described.

In cases of a painful corn at the tip of the toe, a U-shaped incision is made parallel to the distal edge of the nail and slightly to the plantar side. The distal part of the nail phalanx is exposed and removed, followed by the usual operative procedure for correction of the hammer-toe (Fig. 1).

We have had several cases where the hammer-toe deformity was complicated by rotation of the distal phalanx, and occasionally also of the middle phalanx (most commonly toward the tibial side). We were able to correct the rotation by resuturing the dorsal flap in a slightly oblique direction, with somewhat more tension on one side. (See Figures 4-B and 5-B.)

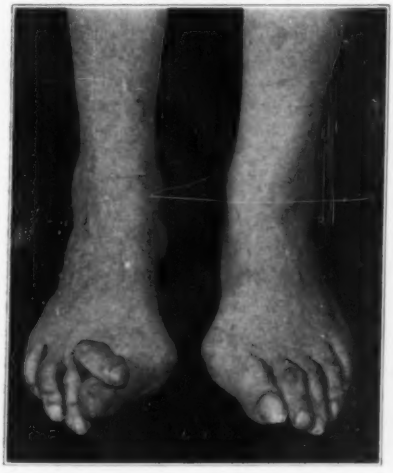

FIG. 5-A

Before operation

FIG. 5-B

After operation

Case 2. Woman, thirty-seven years old, with extreme bilateral metatarsus varus primus with hallux valgus. There was marked deformity of the right second, third, and fourth toes, with complete dorsal dislocation of the basal phalanx of the second toe. An operation was performed three years ago. Note correction of all the hammer-toe deformity, as well as the hallux valgus and metatarsus varus. Some overcorrection of the right big toe developed after the operation.

END RESULTS

Although a much greater number of patients were operated upon by this method, only seventeen patients with thirty operated toes are included in this report. The rest of the cases have not been considered because of incompleteness of the records or of the follow-up. Good results were obtained in fourteen patients (twenty-six toes), a fair result in one patient (one toe), and poor results in two patients (three toes).

The reason why we have preferred to use this technique in the majority of our cases during the past five or six years is that correction of the deformity is obtained with the least sacrifice of appearance and of function. In some of our cases we have even been able to correct the deformity with preservation of motion in the interphalangeal joint.

In conclusion, we wish to state that in our hands the operative procedure described seems to give quite satisfactory and permanent results in properly selected and well-analyzed cases. It is not offered as a panacea for all cases of hammer-toe.

THE ORTHOPAEDIC TREATMENT OF STRÜMPELL-MARIE ARTHRITIS *

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From the Robert B. Brigham Hospital, Boston

This report is based on the study of 106 cases of Strümpell-Marie arthritis, or ankylosing spondylitis, extending over a period of twenty-two years. There were twenty-two females and eighty-four males.

Strümpell-Marie arthritis involves the ligaments and articular facets of the spine in young adults. No specific cause for the disease is yet known and none of the many theories have been proved. The bone bridging from vertebra to vertebra begins at the points of greatest strain. In the roentgenograms of this series of cases, the first bridging was seen between the twelfth thoracic and the first lumbar vertebrae. In some cases the entire spine is stiff, due to ossification of the intervertebral ligaments or to fusion of the articular facets. The disease is progressive, involving either the whole spine or only isolated areas.

In this series, the typical rounded "bamboo" spine was produced by ossification of the ligaments, leaving the intervertebral spaces apparently intact. Most patients came for advice because of stiffness in bending or pain in the ribs on breathing or on moving. The ribs became fused at the articulations, so that chest motion was sometimes completely lost. This was especially true when bad posture was present. The sacro-iliac joints were fused early in all of the 106 cases. After fusion was complete, the disease stopped. In some cases, the hips became fused also.

At first the stiffness is due to intense, prolonged muscle spasm of all of the spinal and abdominal muscles, which are held rigid. The pain on motion is so severe that this constant protection apparently is necessary for relief. Ultimately, this pain subsides, as either the inflammation disappears or ossification of the ligaments takes place, so that motion no longer irritates. The present studies indicate that the muscle spasm exists for some years before the actual ossification takes place. In the author's experience, correction can be accomplished up to five years. This gives an opportunity to correct the posture before actual fusion takes place.

The author's theory has been that ossification represents the result of nature's method of permanent immobilization of the spine to prevent strain and motion and inflammation in the ligaments. If one follows nature's lead early enough in the spasm stage and immobilizes the spine, ossification may not be necessary, because trauma will be less, strain will be gone, spasm will be unnecessary, and healing will take place more

* Read at the Annual Meeting of the American Orthopaedic Association, Buffalo, New York, on June 6, 1939.

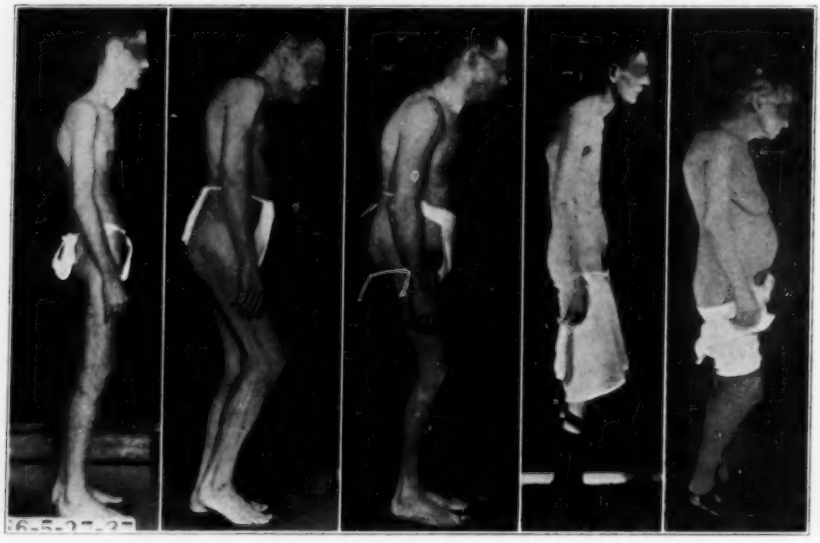

FIG. 1

Characteristic spinal deformities, resulting from muscle spasm in Strümpell-Marie arthritis. No jackets were used.

rapidly and more normally, possibly without fusion. Therefore, to get the best results, the author believes that orthopaedic treatment should begin as early as possible,—at least within the first three years, although much can be done up to nine years. Bad forward bowing is very common, as the muscle pull is continuous and the drag forward is very strong, according to the statements of the patients. The deformity presents itself as a long bend of the whole spine, and it produces a reverse curve in the lumbar region, so that in standing the pelvis is actually tipped backward and constant strain is then thrown on the hip joints by this abnormal position (Fig. 1). A characteristic walk is produced: the feet toe out; the hips are rotated outward; and the legs are pushed rather than swung in front of the patient.

FIG. 2

Extreme deformity with flexion of the hips and the spine. Note the round shoulders and the lack of normal lordosis.

The experiments with posture and support suggest that the hip involvement may be secondary to the strain induced by bad posture and loss of normal lordosis. At times a lateral curvature is produced by unequal spasm. The progress is comparatively slow and, except in women, the arthritis rarely attacks the extremities, barring the hips. The

fact that women are more susceptible to atrophic arthritis may account for the greater incidence of involvement of the smaller joints in women. In our group of men, the smaller joints were involved in only five cases.

Prior to 1930, forty-five cases had been treated by orthopaedic measures in an attempt to prevent the usual deformity of rounded thoracic spine, flat upper chest, and buckled body, with protruding head and sometimes with fused hips. Often the body is rigid at an angle of 45 degrees. (See Figure 2.) This deformity seriously impairs usefulness and especially health, as the organs inside of the body are compressed, rib expansion is lost, and any chest infection may prove fatal. The method of correction of this posture was as follows: The patient was kept recumbent, and the spine was gradually hyperextended in bed, first, by removing the pillows under his head until he was either flat or as straight as possible; second, by using plaster half-shells to support and to stretch the spine while in bed. Relaxing hot fomentations were applied to the whole spine twice daily for twenty minutes, and corrective exercises to straighten the body and to expand the chest were taught and supervised morning and evening. When the back was as straight as it seemed possible to make it, steel braces, which drew the shoulders back, were fitted or short spring braces with elastic shoulder straps were tried; even corsets were used at times to reinforce the braces.

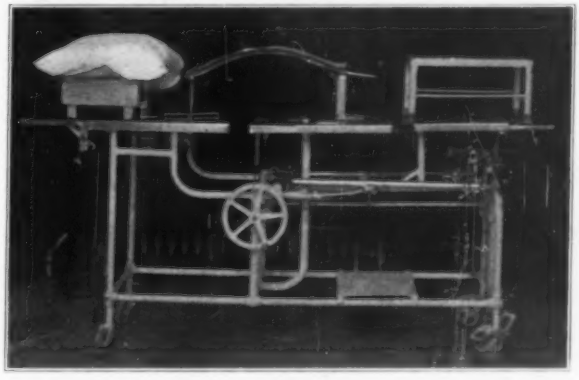

FIG. 3-A

Goldthwait frame with steel bars bent to produce a lordosis.

FIG. 3-B

Position of the patient on the frame with the spine hyperextended and the arms raised to expand the chest. The legs are extended to tip the pelvis forward and to develop a lordosis.

In 1930 a review of the results (Table I) showed that, of the forty-five patients thus treated, thirty-five had completely fused spines, and thirty-one had poor

posture in spite of treatment. The chest expansion was poor in many. Twenty patients had lost all hip motion and could hardly walk, and nine had died, usually from chest infection. The results were so unsatisfactory from a postural standpoint that a better method of preventing deformity had to be devised; therefore, jackets were tried. In many cases, where very little motion appeared to be present, it was found that, after recumbency on a shell in a position of hyperextension, the spine could be straightened, and, best of all, when the patient was completely immobilized in a jacket for several months, motion in the spine was increased rather than lost by the fixation. Therefore, with the exception of the use of the jacket, no change was made in the previous treatment. In certain cases, correction of the posture in bed takes weeks, while in others less time is required.

As more cases were observed, the belief grew that, as in other types of atrophic arthritis, the trauma of use, as well as that of muscle spasm, kept the disease active in the inflamed ligaments. After complete bony ankylosis, the disease apparently ceased. Why not immobilize the back early, continuously, and adequately and give it as complete a rest as possible to see what would happen over a long period of time until the disease was quiescent? It could do no harm. In the first forty-five cases treated with braces, the spine became stiff, too frequently in bad posture. Good posture, even if the spine were stiff, was some gain.

Just how long Strümpell-Marie arthritis remained active was unknown; also when it was safe to stop immobilization was a question. The plan then was first to correct the posture, just as we had done before, and then to immobilize the spine in good posture in a jacket as long as was necessary. According to the practice now adopted by the author, if the spine is not straightened by the end of two weeks, a jacket is applied, and renewed at regular intervals.

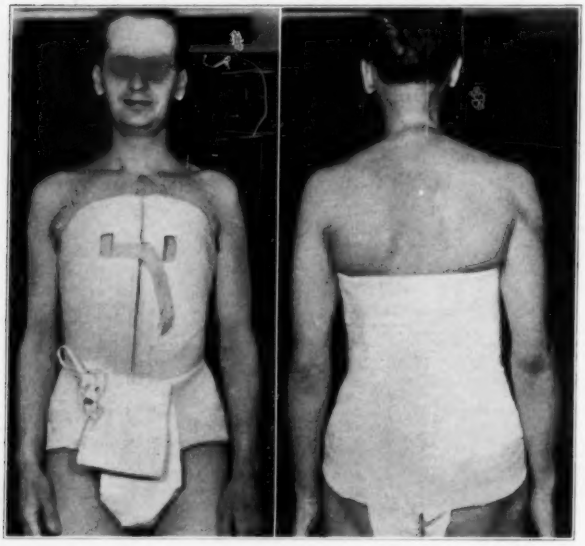

FIG. 4

Showing the early plaster jacket used for support and correction before the leather jacket is made. The front is high and the back low to permit straightening of the thoracic spine by breathing.

The technique of applying the jacket is as follows: The patient is placed on a Goldthwait frame, consisting of two bars

TABLE I

ANALYSIS OF FORTY-FIVE CASES TREATED WITHOUT JACKETS BEFORE 1930

Weight	*Cases*	Posture	*Cases*	Chest Expansion	*Cases*	Hips	*Cases*	Spine	*Cases*	Capacity for Work	*Cases*
Loss	10	Poor	31	Less	6	Involved	26*	Fused solid	35	Working	9
Same	4	Same	10	Same	5	Fused 20		Bridged	2	Unemployable	16
Gain	9	Improved	4	Improved	13	Worse 6		Unknown	8	Unknown	11
Unknown	22			Unknown	21	Normal	9			Died	9
						Unknown	10				

* Of 26 hips which became steadily worse, 20 fused completely.

TABLE II

ANALYSIS OF TWENTY-THREE CASES TREATED WITH JACKETS FOR FROM FOUR TO NINE YEARS SINCE 1930

Weight	*Cases*	Posture	*Cases*	Chest Expansion	*Cases*	Hips	*Cases*	Spine	*Cases*	Capacity for Work	*Cases*
Loss	1	Poor	3	Less	7	Involved	11	Fused	3*	Working	16
Same	2	Same	5	Same	2	Fused 3		Bridged	17†	Employable	6
Gain	20	Improved	15	Improved	14	Improved 7		No bridging	3	Died	1
						Worse 1					
						Normal	12				

* Fusion complete before jackets were applied.
† In 4 of these there was no bridging at first; in 13 bridging progressed.

TABLE III

LENGTH OF PERIOD DURING WHICH JACKET HAS BEEN WORN IN SIXTY-TWO CASES SINCE 1930

Period (*Years*)	No. of Cases
6 to 9	6
5	7
4 to 4½	10
3 to 3½	9
2 to 2½	9
1 to 1½	8
Less than 1	13
Total	62

of malleable steel, which are bent to produce a lordosis (Fig. 3-A). The arms are raised over the head to expand the chest, and the legs are stretched out to tip the pelvis forward as far as possible (Fig. 3-B). Then a light plaster jacket, well padded over the spine, the anterior superior spines of the ilium, and the sternum, is applied. The jacket is molded tightly over the abdomen to limit abdominal breathing, to force the chest up, and to compel upper expansion of the chest. It is left high in front and cut just below the shoulder blades in back, so that with each breath the chest is forced against the jacket in front, thus straightening the thoracic spine. (See Figure 4.) The plaster extends to the symphysis in front and the tip of the spine in back and firmly grips the pelvis. There must be no space below the jacket which will permit abdominal breathing, in order to ensure breathing in the upper chest. The ribs are held up and cannot sag. The back cannot bow forward, as the front of the jacket is high, and the lordosis is maintained by the shape of the jacket.

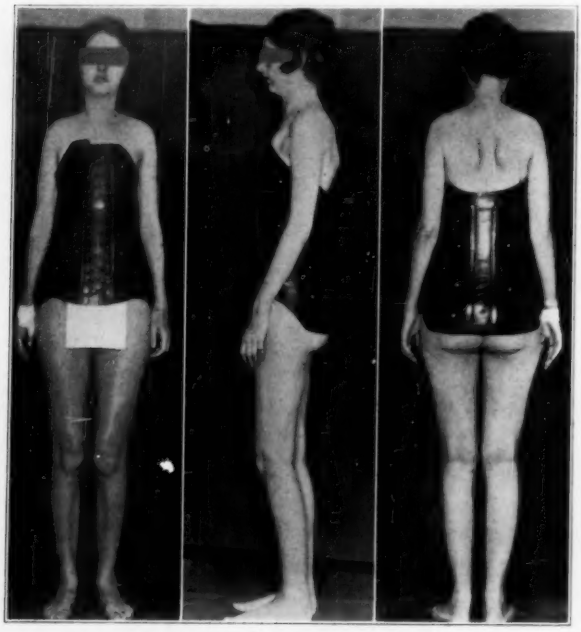

FIG. 5

Showing the waxed leather jacket, steeled in back and laced in front. It is cut low in back and high in front. Breathing thus corrects the rounded thoracic spine.

Except in a few cases, the jacket is not uncomfortable and can be left on. In a few instances, during the first night the patient cannot breathe comfortably, and sedatives have to be used or the upper third of the jacket has to be opened in front. Within twenty-four hours, rib pain has usually gone, and breathing is easier and

deeper. The peculiar tension in the hips subsides, and the constant forward pull of the neck disappears. Most patients state that this tension of the neck goes during the first few hours that the jacket is worn. Most of the patients are more comfortable when held firm, and they dread having the jacket removed.

At the beginning of the experiment, in each case the jacket was removed after a few days by splitting the front. It was then used as a removable jacket, but it was found that some of the immobilizing effect was lost in this way. It has now been found necessary, in order to obtain the desired amount of rest, to keep the jacket on uninterruptedly for several weeks, until all spasm has gone. Then only are new jackets made.

FIG. 6

Illustrating the remarkable change in posture which took place from December 13, 1938, to February 20, 1939, after the wearing of one plaster jacket.

The necessary number of plaster jackets are applied until the best possible correction has been obtained. Then a more permanent leather jacket is made on a plaster model, taken from the body. The leather jacket is made by filling the last cast with plaster and binding wet sole leather on this mold until it is dry. It is then waxed, steeled in back, and laced in front. It is cut high in front and low in

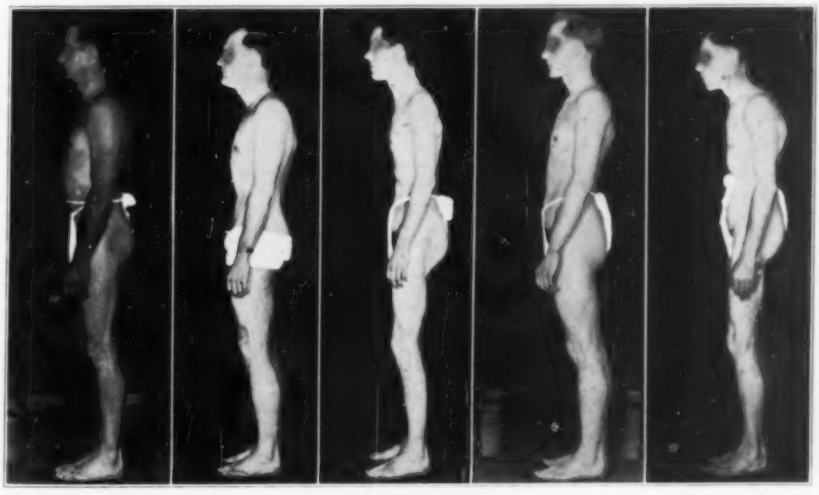

FIG. 7

Early use of jackets for three years or more prevented the characteristic deformity of the spine in these cases. Compare with Fig. 1.

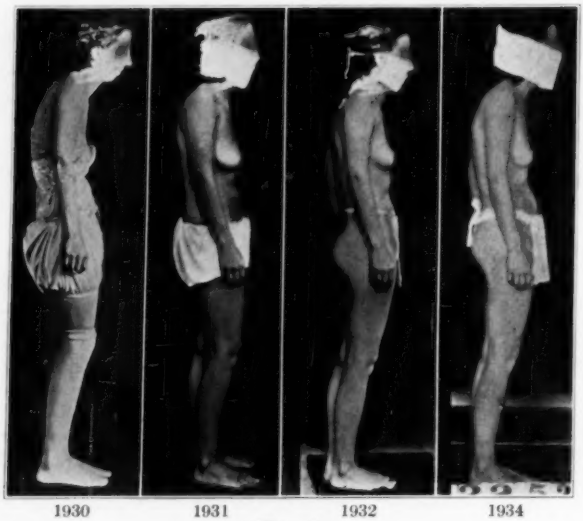

FIG. 8

Showing the return of poor posture after the patient refused to wear her leather jacket in 1933. Note the similarity between the deformity in 1930 and that in 1934, in spite of the improvement in 1931 and 1932.

back, just as is the plaster jacket. (See Figure 5.) This jacket, being waxed, will last for several years.

The use of the jacket is continued, in most cases day and night. It has been the author's experience that the danger of trouble with the hips is increased by lying in bed and by the loss of the lumbar curve, so that the patient is gotten up after the jacket is hard and, with each jacket, a greater lordosis is attempted. Walking is encouraged as the adductor spasm goes.

The results have been more than encouraging (Fig. 6). The spasm and pain disappear rapidly during the first few days. The general condition improves with the lessened pain and better nights of rest. From the patients' standpoint, the jackets have given the greatest relief to the hips, ribs and neck that they have experienced. From the orthopaedic point of view, postural deformity has not occurred, chest expansion has increased, and the general health has been better.

Sixty-two patients have worn jackets. All were symptomatically far better because of the jackets (Fig. 7) and were made more comfortable, except for three who were uncooperative. All have preferred to wear their jackets than to go without them. It seems right, however, to draw our conclusions about the physical effects from only twenty-three cases in which jackets have been worn for from four to nine years (Tables II and III). Of these twenty-three cases, good posture was maintained in five, improved in fifteen, and lost in three. One of the three patients refused the jacket after two years (Fig. 8); one cut his jacket in front, so that it no longer supported; and one was uncooperative.

No new hip trouble developed in any of the sixty-two cases. In the group of patients who wore jackets from four to nine years, seven of the eleven patients with hip symptoms at the beginning became completely symptomless; the three patients with fused hips showed no change; one patient was unaccountably worse. Chest expansion decreased in seven cases, was unchanged in two, and increased in fourteen. Weight increased in twenty cases, remained the same in two, and decreased in one.

Sixteen patients are working; six are at home, unemployed but looking for work; and one patient died of carcinoma of the breast.

Some ossification of the ligaments was present to some extent before the jackets were used in thirteen cases, and in these cases the bridging increased in spite of the jackets. In three patients, the fusion was already complete before the jackets were applied. Seven of the twenty-three showed no bridging at all at first, but later in four of these seven cases one or two bridges developed, usually at the twelfth thoracic or first lumbar vertebra. Three of the seven cases, however, showed no bridging, even at the end of four, five, and eight years respectively. There are too few cases and the period during which the jackets have been worn is too short to draw any final conclusions in regard to the prevention of ossification, but the study strongly suggests that the ossification is much less rapid in cases treated with jackets, and the results were superior to those in the forty-five cases previously treated without jackets.

SUMMARY AND CONCLUSIONS

1. Relief from pain, muscle spasm, and strain was rapid and effective in the fifty-nine cases in which the patients cooperated.

2. The usual deformities in posture were prevented in a large majority of the cases.

3. Chest expansion increased.

4. Better general health, as shown by increased weight and ability to return to work, was noticeable.

5. Patients were up sooner and out of the hospital earlier.

6. Not one new hip involvement occurred in any of the sixty-two cases in which the jackets were worn, and seven out of eleven hips with symptoms of involvement improved after the jackets were applied.

7. The experiment suggests that ossification of the intravertebral ligaments is less rapid and extensive where the spine is supported with jackets early in the disease.

8. Jackets have given greater comfort than any form of treatment, according to the statements of the patients themselves.

9. The results following the use of jackets are superior to those which were obtained in the forty-five cases previously treated with other forms of support.

BONE METASTASIS FROM PRIMARY CARCINOMA OF THE LUNG

Report of an Unusual Case *

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From the Tumor and Surgical Service, Veterans Administration Facility, Hines, Illinois

The purpose of this paper is, first, to stress the high incidence of bone metastasis from primary carcinoma of the lung, and, second, to report a case in which the site of the metastatic lesion was in the left superior maxillary bone. No mention of a similar case has been found in the literature.

Although carcinoma of the lung is becoming increasingly important from both the diagnostic and therapeutic standpoints, little emphasis has been placed upon the incidence of bone metastasis. Mattick, in a study of sixty-five cases of primary carcinoma of the lung, found bone metastasis in nineteen, or 29 per cent. In his series, bone was the most frequent site of metastasis. The bones involved and the incidence were as follows: ribs, 10 per cent.; vertebrae or clavicle, 8 per cent. in each; skull or femur, 4 per cent. in each; pelvis or sternum, 2 per cent. in each. Rosedale and McKay found involvement of the bones in twelve, or 32 per cent., of thirty-seven cases in which autopsies were performed. Only those bones to which attention had been directed clinically were dissected. Koletsky found bone metastasis in 19 per cent. of 100 cases of primary carcinoma of the lung which came to autopsy. Arkin and Wagner reported bone metastasis in twenty-one, or 28 per cent., of seventy-four cases of malignant lung tumor which came to autopsy. The bones involved were the ribs, skull, pelvic bones, scapula, and clavicle, listed in the order of frequency. The lowest incidence of bone metastasis was reported by Graham, who found only two instances in thirty cases of primary lung carcinoma which came to autopsy. Copeland found four instances of bone metastasis in twenty-four cases of primary lung carcinoma, or 17 per cent. Adler, reporting 327 cases of primary pulmonary malignancy, noted bone metastasis in forty-seven cases, or 14 per cent. Stein and Joslin, in a study of 100 cases of primary lung carcinoma which came to autopsy, found bone metastasis in fifteen cases, or 15 per cent. In only eighteen of the 100 cases were the bones specifically studied for bone metastasis. No cases of apical lung carcinoma were included in this group, because in cases of this type the rib or vertebral involvement is by extension from the primary lung tumor and not by metastasis.

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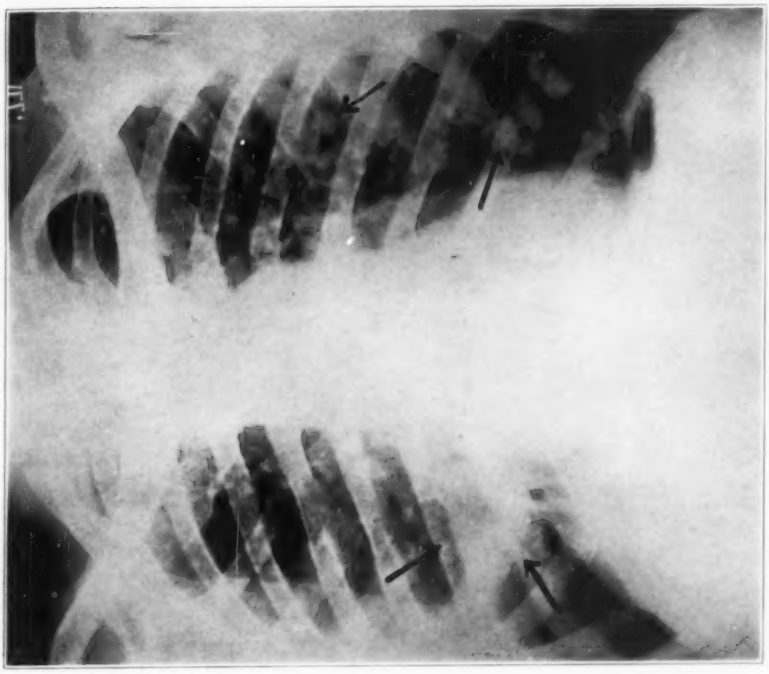

FIG. 2

Roentgenogram taken three months later, showing metastatic nodules present in the left lung.

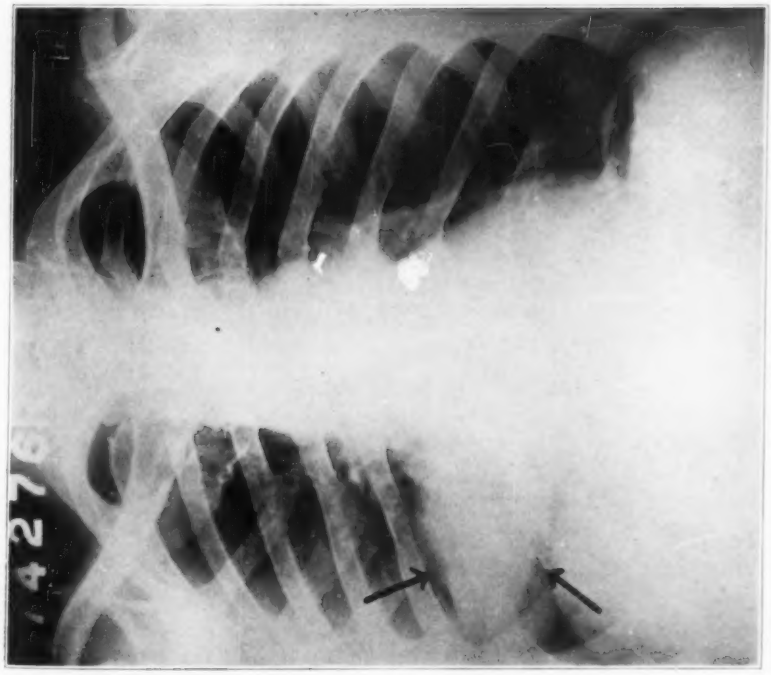

FIG. 1

Arrows indicate site of primary lung carcinoma in the right middle lobe.

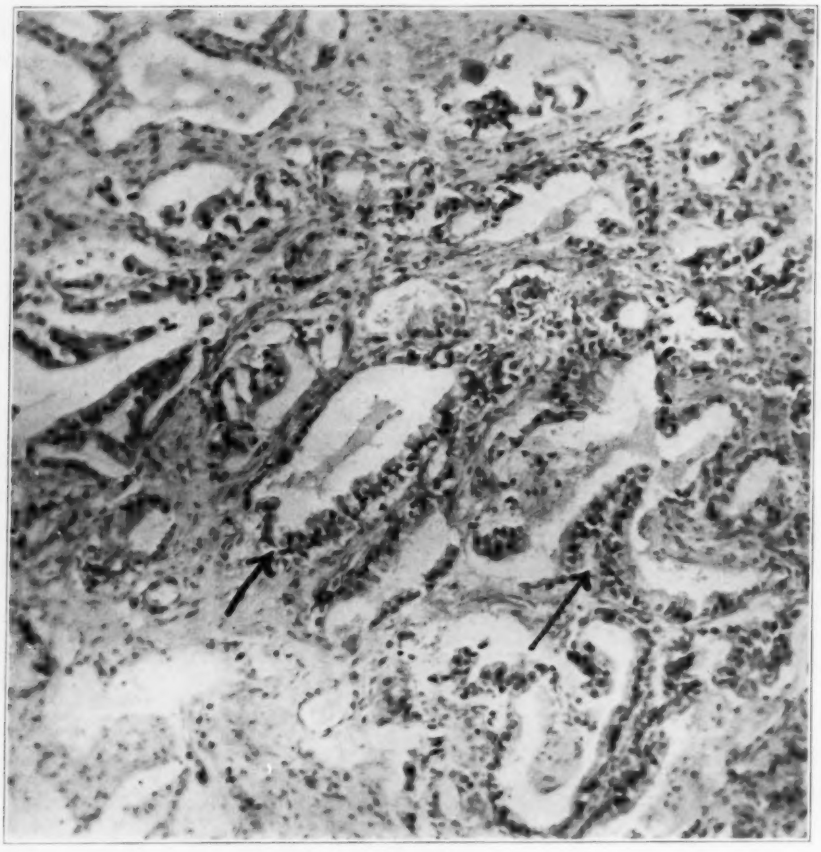

FIG. 3

Photomicrograph of the primary adenocarcinoma of the lung.

REPORT OF CASE

A colored male, aged forty-five years, a laborer, was admitted to Hines Hospital, on February 12, 1938. He stated that for the six months prior to his admission he had had pain in the right chest, a cough with expectoration of blood-tinged sputum, weakness, loss of weight, and dyspnoea. His symptoms had become progressively worse. Until the previous six months, his general health had been good, with the exception of pneumonia involving the right lung in 1918.

Roentgenograms of the chest, taken on February 16, 1938, revealed a heavy shadow of increased density in the region of the right middle lobe. On examination on March 5, 1938, the shadow appeared to be slightly larger. Bronchoscopic examination was recommended at this time, because the roentgenogram of the chest was not conclusive of carcinoma of the lung. The patient refused this procedure and left the Hospital on March 8, 1938, because of a serious illness in his family. All examinations were essentially negative with the exception of findings of consolidation of the right middle lobe of the lung. Five sputum examinations were negative for tubercle bacilli. The Wassermann and Kahn tests were reported as negative. Urinalysis and complete blood count were essentially negative.

The patient was readmitted on May 12, 1938, because of an increase in his symptoms. There was impairment to percussion on the right from the lower angle of the

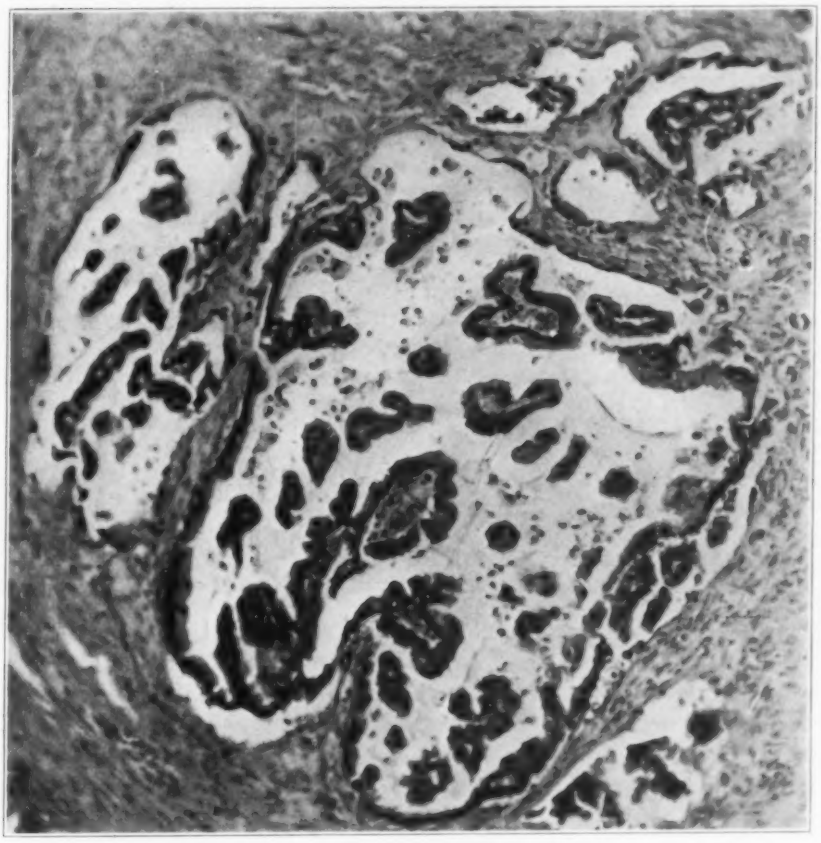

FIG. 4

Photomicrograph of biopsy specimen taken from left superior maxillary bone, showing metastatic adenocarcinoma.

scapula to the base. Breath sounds were distant over this area. No definite râles were heard. The patient was poorly nourished and appeared to be ill. Temperature, pulse, and respiration were within normal limits. Roentgenographic examination on May 17, 1938, showed a soft, flocculent, snowstorm-like effect throughout the right and left lobes, which resembled metastases.

Bronchoscopic examination on June 14, 1938, revealed a bulging of the medial and posterior walls of the right main bronchus. Because of the presence of a tumor-like mass, a biopsy was done. The histological report was adenocarcinoma of the bronchus. The patient was given irradiation therapy from July 2, 1938, to August 31, 1938, receiving a total of 3400 roentgen units to the right chest. Following this, he had less pain and the cough was considerably improved. In September 1938, a moderately firm swelling in the region of the left superior maxillary bone was noted. This lesion increased in size rapidly. There was no associated pain or discomfort. A biopsy was done on September 28, 1938, from which a diagnosis of metastatic adenocarcinoma from the lung tumor was made. The patient left the Hospital on September 30, 1938, again because of serious illness in his family.

A study of the literature reveals a reported high incidence of bone metastases from primary carcinoma of the lung.

The majority of the cases have been of the osteoclastic type. When cases of osteoclastic bone lesions are seen, carcinoma of the lung must be suspected as well as metastatic lesions from the breast, thyroid, kidney, and less frequently, from melano-epithelioma, ovary, and Hodgkin's disease.

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AMPUTATION OF THE FOOT, WITH CALCANEOTIBIAL ARTHRODESIS

BY H. B. BOYD, M.D., MEMPHIS, TENNESSEE

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The unsatisfactory end results of amputations through the region of the tarsus, and the fact that excellent artificial limbs are now obtainable, have led to the custom of amputation of the leg at the site of election for lesions involving the tarsus. There are several disadvantages to this principle. Patients object to amputation higher than appears necessary, and some prefer amputation through the foot to the use of an artificial limb. Further, all patients are not financially able to buy a prosthesis and to keep it in repair. When the proper anatomical conditions are present, the following amputation, with calcaneotibial arthrodesis, which obviates the expense and inconvenience incident to the use of a prosthesis, can be recommended.

The ankle is exposed through a curved lateral Kocher incision; the astragalus is removed by the method of Whitman; and any remaining tarsal bones, with the exception of the os calcis, are also excised. The articular cartilage from the superior surface of the os calcis and from the entire mortise of the ankle joint is removed. The os calcis is then shifted anteriorly until the weight-bearing surface of the heel is directly beneath the long axis of the leg, and is accurately fitted into the ankle mortise; this necessitates removal of a portion of the sustentaculum tali. The surfaces of the os calcis in contact with the malleoli should be stripped of periosteum and the cortex should be abraded. The anterior surface of the os calcis and approximately one centimeter of the contiguous bone are removed. The plantar skin flap should be sufficiently long to cover the anterior portion of the os calcis. The resulting scar passes just below the lateral malleolus and around the front of the ankle joint.

By this amputation, the weight of the body is transmitted through skin and subcutaneous tissue, well-adapted by nature for weight-bearing. Although the patient's gait lacks the resiliency offered by an artificial limb, a natural, painless stump is provided.

For the average patient having an office occupation, amputation of the leg at the site of election and the use of an artificial limb will give a functional member with a better cosmetic result than the procedure described. It is difficult, however, for a day laborer to obtain employment while wearing an artificial appliance. This operation enabled the patient in the following case to return to his former occupation without the handicap of a prosthesis.

CASE REPORT

C. W., male, aged twenty-one years. On August 22, 1936, the patient's forefoot had been run over by a train. He was taken to the John Gaston Hospital, where a débride-

FIG. 1-A

FIG. 1-B

Fig. 1-A: Photograph of foot before calcaneotibial arthrodesis. The stump is in equinus, and there is a small ulcerated area at the site of amputation.
Fig. 1-B: Roentgenogram of foot before calcaneotibial arthrodesis.

ment and an amputation through the metatarsal bones were performed. Subsequently, he was admitted to the Hospital on five occasions; each time a skin graft was applied, and on one admission the foot was reamputated through the midtarsal joint. Two of the grafts were successful, but after each operation the skin failed to withstand weight-bearing and soon became ulcerated over the anterior portion of the stump.

The writer first saw the patient in consultation on August 11, 1938. The photograph and roentgenogram (Figs. 1-A and 1-B) show the condition of the foot at that time. The operation described was conceived and proposed.

On August 25, 1938, two years after the accident, a calcaneotibial arthrodesis was carried out, and a plaster cast was applied from the upper thigh to the heel, with the knee immobilized in flexion. The patient's convalescence was uneventful. On the twenty-second postoperative day the cast was removed, a walking cast was applied, and walking was allowed. After six weeks, the patient was permitted to walk in a leather ankle corset with a one-inch elevation under the stump. Roentgenograms taken nine weeks postoperatively revealed beginning fusion between the os calcis and the tibia; those taken six months after the operation demonstrated solid fusion between the os calcis and the ankle mortise (Figs. 2-A and 2-B). Figures 3-A and 3-B show the stump in the weight-bearing position.

This patient states that he has no pain, and can walk more than ten miles a day. He works as a day laborer, pushing a wheel barrow loaded with sand and gravel.

A study of the literature subsequent to this operation discloses many types of amputations through the tarsus, none of which has been sufficiently satisfactory to be popular at the present time. In Chopart's amputation, the stump is usually drawn into equinus by the triceps surae; this forms a poor weight-bearing surface and frequently leads to necrosis and ulceration of the skin. Pirogoff's amputation also provides a poor weight-bearing area, as the posterior surface of the os calcis, on which the

tendo achillis is inserted, is ill adapted both anatomically and physiologically for weight-bearing. Ricard introduced a valuable modification of Pirogoff's amputation, similar to the procedure described in this paper, wherein the normal weight-bearing surface of the heel was preserved; he

FIG. 2-A FIG. 2-B

Anteroposterior and lateral roentgenograms, showing fusion between os calcis and ankle mortise six months after operation.

FIG. 3-A FIG. 3-B

Anterior and lateral views of the stump in the weight-bearing position following amputation of the foot, with calcaneotibial arthrodesis.

did not, however, fuse the os calcis to the tibia. He stated: "The anterior tendons of the leg are solidly sutured to the posterior and plantar tendons, in order to obtain a sling to maintain the calcaneum in good position . . ." Kofmann has recently described a modification of Ricard's operation, in which the anterior tendons of the leg are transplanted through a drill hole in the anterior portion of the os calcis. The tendons thus serve as antagonists to the tendo achillis, preventing equinus. Both the Ricard and Kofmann amputations allow motion between the os calcis and the ankle mortise. From a mechanical standpoint, such a joint is imperfect and is, therefore, a potential source of traumatic arthritis and pain. Moreover, attempts to obtain stability in weight-bearing joints by tendon suspension have generally proved less successful than by arthrodesis.

According to Burghard, on April 24, 1907, Mr. Gordon Watson presented at the Clinical Society two patients who had had amputations practically identical to the one described herein. The operations were performed for "long-standing talipes equinus due to infantile paralysis". Burghard stated: "The resulting stumps were excellent in all respects; the patients could walk, run, and jump upon them without the least inconvenience."

CONCLUSIONS

For the patient who cannot afford an artificial leg, or for the laborer, the amputation with calcaneotibial arthrodesis, as described, gives an excellent weight-bearing stump and relieves the patient of the inconvenience incident to the use of an artificial limb. The operation is more advantageous both from an anatomical and from a physiological standpoint than other amputations through the region of the ankle or the tarsus.

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OPEN FIXATION OF INTRACAPSULAR FRACTURE OF THE FEMUR

An Improved Technique

BY OTHO C. HUDSON, M.D., F.A.C.S., AND WILLIAM P. BARTELS, M.D.,
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In order to reduce the number of wound infections, postoperative reactions, and unsatisfactory placements of the Smith-Petersen nail following the open reduction and fixation of intracapsular fractures of the femur, the authors have experimented with various operative techniques during the past five years. From this experience, an operative procedure has been evolved which definitely reduces the hazards of the open-fixation method of treatment. The important points of this procedure are essentially two in number,—the surgical approach and the actual technique of inserting the Smith-Petersen nail.

SURGICAL APPROACH

As the operation for fixation of fracture of the femoral neck must often be performed on elderly individuals in poor general condition and with poor tissue vitality, any approach which necessitates extensive section and stripping of muscles or fascia should be condemned. Again, inasmuch as one very important merit of treatment by the Smith-Petersen nail is the permission of early, painless, active motion of the affected hip, the muscles controlling the hip joint should not be disabled by detachment of their origins or insertions or by section of their blood or nerve supply. The approach advocated is an anterolateral one to the femoral neck along the anterior border of the gluteus medius, with retraction of the tensor fasciae femoris medially and forward.

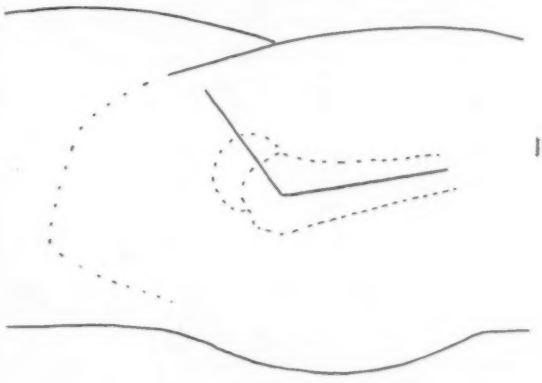

FIG. 1
Line of incision.

With the extremity held in neutral rotation, the skin incision is made, beginning two inches below the anterior superior iliac spine and extending downward to a point just below the tip of the greater trochanter, thence directly downward in the plane of the middle of the lateral aspect of the

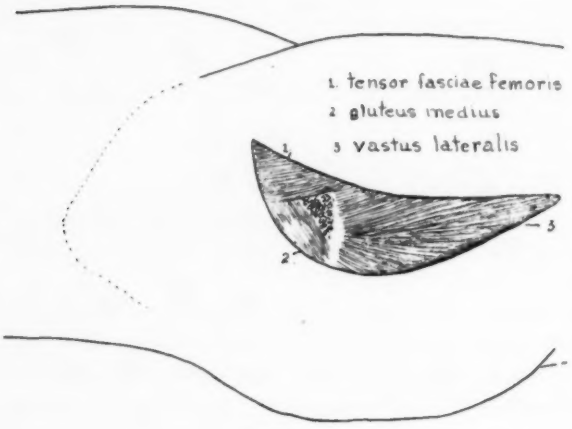

FIG. 2

Showing the space between the gluteus medius and the vastus lateralis through which the femoral neck is approached. The tensor fasciae femoris lies in front.

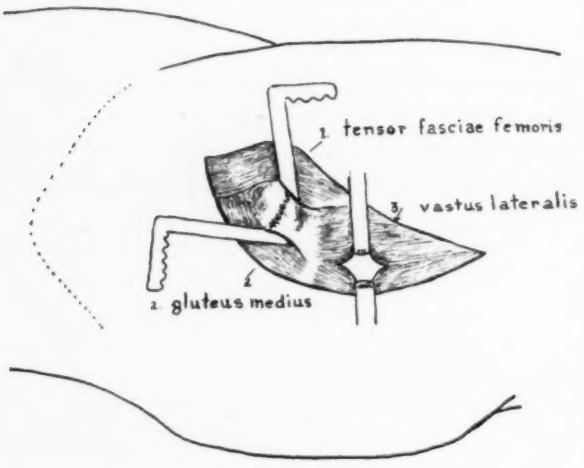

FIG. 3

Exposure after incision and retraction of the capsule.

shaft of the femur for a distance of six inches (Fig. 1). A strip of gluteal aponeurosis, running down between the greater trochanter and the posterior edge of the tensor fasciae femoris to blend with the fascia lata, is seen and is divided in the line of the skin incision (Fig. 2). Beneath this fascia is a small amount of loose areolar tissue, filling the space between the anterior edge of the gluteus medius and the anterior origin of the vastus lateralis. Beginning at the greater trochanter, by dissecting medially in this loose tissue, the anterior border of the gluteus medius is exposed. By retracting the gluteus medius backward and upward and the tensor fasciae femoris medially, a good view of the anterior surface of the neck of the femur and capsule of the hip joint is obtained. Beginning at the acetabular margin, the capsule is incised in the line of the neck of the femur. A pair of specially designed, curved retractors (Figs. 4-A and 4-B) are inserted through the capsular opening, one on either side of the neck. These are held continuously by an assistant and provide retraction to secure a good view of the fracture site (Fig. 3).

METHOD OF INSERTING NAIL

The femur is internally rotated, and an incision is made through the vastus lateralis and the periosteum over the upper portion of the lateral aspect of the shaft of the femur.

A trefoil nail of proper length is selected and is driven in until it begins to emerge from the fractured surface of the neck. The angle of the path of the nail is gauged through direct, visual inspection of the shaft, the greater trochanter, and the neck stump through which it is to travel. If the tip of the nail emerges off center at the fractured surface, it is partially withdrawn, redirected, and driven in until it emerges exactly through the center. The fracture is then reduced by the Leadbetter manoeuver. Following reduction, the extremity is held in full abduction, internal rotation, and extension by an assistant. The tip of the nail being at the fracture line, the distance the head is penetrated corresponds to the distance the nail now travels as it is driven home. Under-penetration and over-penetration are avoidable. Firm impaction of the fragments is accomplished with a heavy hammer, and the result is tested by rotating the extremity.

REMARKS

The operative technique described has been followed by the authors in a series of nineteen cases. One wound infection and one death occurred. Most of the cases are too recent to evaluate the percentage of

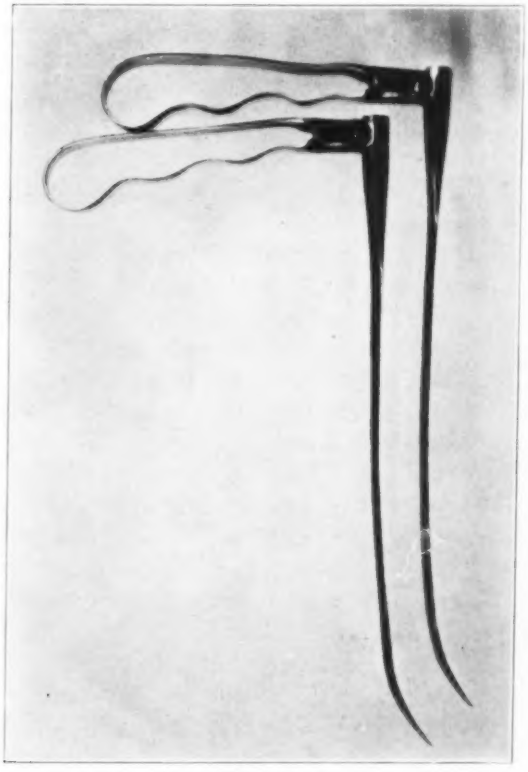

FIG. 4-A

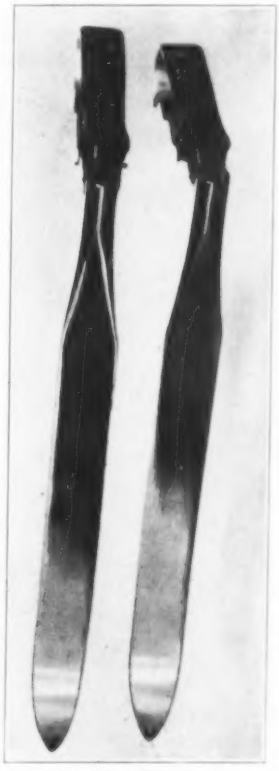

FIG. 4-B

Lateral and anteroposterior views of rigid long-bladed retractors.

osseous union. The authors consider the method to have the following advantages:

Surgical Approach

1. Adequate visualization of the fracture site, the neck, the greater trochanter, and the shaft of the femur, for proper control of direction and penetration of the trefoil nail, is provided.

2. The approach allows minimum tissue section, for it is entirely along anatomical cleavage planes. This factor is important in elderly patients with poor tissue vitality, in whom aseptic necrosis may follow extensive dissection.

3. By means of this approach, the large blood vessels or the important nerves are avoided. Very few bleeders are encountered. Loss of blood rarely exceeds two ounces.

4. The approach is conducive to rapid performance of the operation. The average operating time for the authors is twenty minutes with general anaesthesia, and thirty-five minutes with local anaesthesia.

5. Due to the backward directed incision, the wound drains well in the first twenty-four hours after operation, thus reducing the occurrence of wound hematomata.

Method of Inserting Nail

1. This technique ensures the passing of the nail through the fracture site in the line of the center of the femoral neck without chance of error.

2. It provides exact information as to the depth of penetration of the nail into the head.

TEMPERATURE-CONTROLLED HEALING OF EXPERIMENTAL FRACTURES *

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In 1936, Huggins, McCarroll, and Blocksom reported on studies concerning changes in outlying bone marrow accompanying a local increase of temperature within physiological limits. To obtain a continued elevation in temperature of bone marrow, they denuded the skin of the tails of albino rats and then surgically anastomosed the otherwise intact structures to the abdominal walls, so that the tails of the rats were inserted into and maintained inside the peritoneal cavities of their owners. The result of each transplantation was an increase in vascularity, in protein framework, and in hemopoiesis in that portion of the tail which was subjected to chronic elevation of temperature, as compared to the cooler outside loop and the normal tail. All such tail loops suffered interference with motion, but this was restricted in the outside as well as in the inside portion, so that the effect was evenly distributed in each animal.

Based on these experiments, we believed that, by controlling the temperature of a fractured limb buried in the warm peritoneal cavity, it would be possible to compare the healing power and the callus formation of this limb with a homologous limb fractured and kept outside. Consequently, the object of our experiments was to observe by clinical, roentgenographic, and histological examinations the differences that might take place in the fracture areas of two groups of young guinea-pigs, weighing 450 to 480 grams, the fractures to be produced as nearly as possible in the same manner and position in the foreleg of each animal. Of the sixty-six animals which made up the two groups, forty-five lived to complete the experiments.

FIG. 1

Guinea-pig four weeks after fracture of the denuded right foreleg, amputation of foot, and insertion of foreleg into the abdomen for maintenance of elevated temperature.

Both bones of the right foreleg of each animal in one group were fractured in the middle third. All the skin from the

* Read at the Annual Meeting of the American Orthopaedic Association, Buffalo, New York, on June 7, 1939.

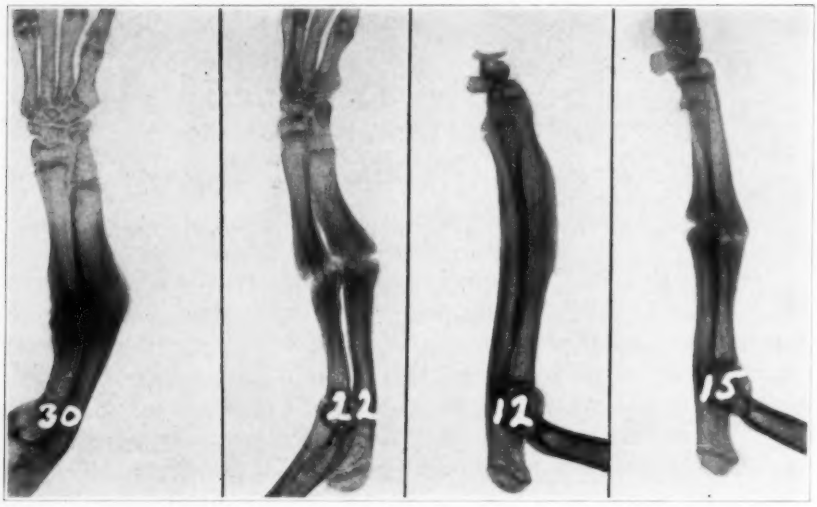

FIG. 2

Roentgenograms of fractured forelegs left outside the abdomen. Specimens obtained four weeks after fracture. Specimens *30* and *22* had no splintage; *30* shows the best bony union in this group and the most deformity. Specimens *12* and *15* were splinted; *12* shows the best result in this group. Specimens *22* and *15* well represent the average roentgenographic appearance of the fractures of four weeks' duration. Note the large amount of callus and the good position of the fragments.

mid-upper right leg, down to and including the skin of the foreleg, of each animal in a second group was removed, and an amputation was performed at the wrist joint. The two bones of the foreleg were fractured in a manner similar to that of the first group, and the skinned fractured leg was then inserted into the abdominal cavity through a small aseptic incision made a little below the costal margin. The peritoneum and muscles of the abdominal wall and those of the mid-portion of the upper leg were sutured together. The wound was closed by suturing the skin of the upper part of the foreleg to the skin of the abdomen; the entire foreleg was thus held in the abdominal cavity. The wounds healed by first intention.

It was found early in our experiments that splints of various types were not satisfactory for use on the fractured legs left outside the peritoneal cavity, for either the guinea-pigs soon chewed them off or the splints caused skin lesions. It was noted that the guinea-pigs held the unsplinted fractured legs, which were left outside the abdomen, quite well immobilized against the body, and made no attempt to bear weight on them early. The extremities inserted into the abdomen were not splinted except by the restraint of position and surrounding tissues. In both groups there was motion of varying degrees at the fracture point, and it is believed there was as much motion, if not more, in the group whose forelegs were inserted into the abdomen, for early in the course of the experiment we could see the distal fragments move during respiration. At the end of the experiment, when these legs were removed for study, there were marked angular deformities at the fracture level.

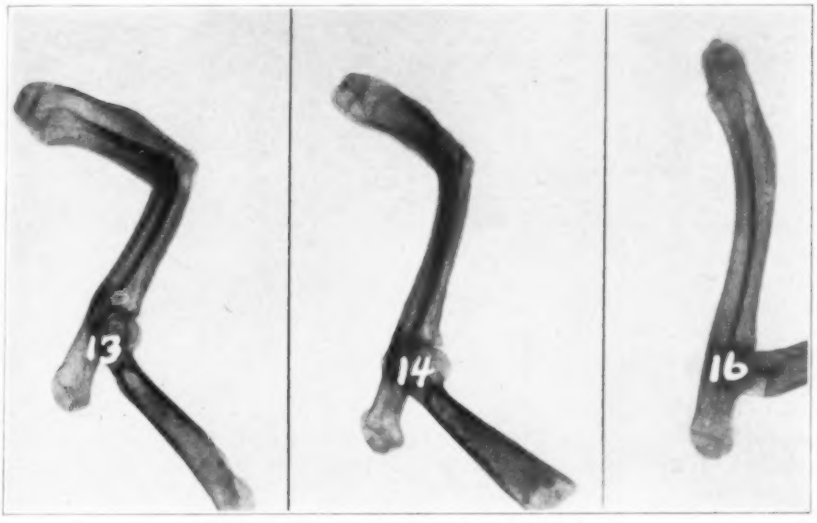

FIG. 3

Roentgenograms of fractured forelegs four weeks after insertion into the abdominal cavity. Specimens *13* and *14* represent average results for this group. Specimen *16* shows the least angulation at the fracture plane. Note the marked deformity and small amount of callus, but definite bony union for the extremities maintained at the elevated temperature.

In the first series of experiments, two groups of guinea-pigs, treated as outlined, were allowed to live for four weeks, at which time the fractured legs were removed and roentgenograms were taken. Seventeen guinea-pigs survived to complete this experiment. In a control group of ten guinea-pigs, the bones of one foreleg of each animal were fractured and the leg was *not* buried within the abdomen. Five of these tolerated plaster splints for from ten to twenty-one days, and five were not splinted. Clinically, all of the fractured forelegs showed firm union. Roentgenographic examination revealed good bony union in four of the five unsplinted forelegs and in two of the five splinted forelegs. Overriding and angulation were present in one foreleg; in the rest the position of the fragments was good. Considerable callus was present at the fracture site in each instance.

In all of the seven forelegs which were fractured and inserted into the abdominal cavity for four weeks, there was clinically firm union, and roentgenographic examination revealed bony union. Six of the seven legs showed a marked angulation of from 90 to 120 degrees. In one leg the fragments were fixed at an angle of 10 degrees. The production of callus was small in the fractured areas.

Both groups showed clinically firm union four weeks after the fracture. Less callus, more deformity, and greater roentgenographic evidence of bony union were present in the group in which the fractured legs were maintained in the abdominal cavity. The bones did not appear less dense upon roentgenographic examination in one group than in the other.

TABLE I

SECOND SERIES OF EXPERIMENTS

Method	No. of Animals	Days after Fracture	Degree of Deformity	Clinical Union			
				Firm	Not Firm	Non-Union	Amount of Callus‡
Foreleg fractured and inserted in abdomen	5	14	3+ to 4+	4	1		1 to 2+
	6	17	3+ to 4+	6			1 to 2+
	1	19	4+	1			1 to 2+
Total	12*			11	1		
Foreleg fractured and left outside of abdomen	3	14	0 to 2+	2		1	2+ to 4+
	10	17	0 to 2+	7	3		2+ to 4+
	1	19	1+		1		3+
	2	21	1+		1	1	2+
Total	16†			9	5	2	

* Of these cases, histological examination showed bony union in 11 and fibrous, cartilaginous, and bony union in 1.

† In this group, histological examination revealed bony union in 1 case; cartilaginous, bony, and fibrous union in 11 cases; and fibrous union in 4 cases.

‡ 1+ to 4+ implies varying amount of gross bulk of callus including all its constituents.

The second series of experiments (Table I) was similar to the first except that the guinea-pigs were sacrificed from fourteen to twenty-one days after the fractures were produced. Both the normal foreleg and the fractured foreleg of each animal were removed, fixed, decalcified, and prepared by the collodion method for histological study. Twenty-eight guinea-pigs completed this experiment.

Of sixteen forelegs fractured and left outside the abdomen, nine showed clinically firm union at the end of from fourteen to twenty-one days; five of the forelegs presented union which was not firm, and two showed non-union. Thirteen of these sixteen guinea-pigs were killed after from fourteen to seventeen days. The forelegs in this group showed much callus grossly and by histological examination. In all of the animals, with the exception of those exhibiting non-union, this callus consisted of a considerable amount of cartilage, along with bony and fibrous callus. In the cases of non-union, only fibrous tissue was present between the fragment ends.

Eleven of twelve fractured forelegs that had been inserted into the abdomen for from fourteen to nineteen days showed firm union clinically, although there existed a marked angulation of from 120 to 90 degrees. The one guinea-pig in which clinical union was not present had been losing weight and appeared to be ill during the fourteen days of the experiment. The eleven healthy guinea-pigs showed good bony union by histological

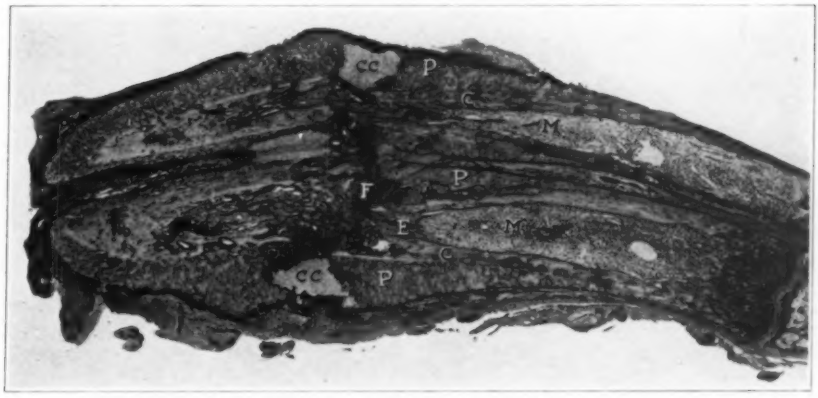

FIG. 4

Photomicrograph of specimen of fractured foreleg left outside the abdominal cavity, which was recovered seventeen days after fracture. This is an example of the average histological finding of this group. Note the large amount of cartilaginous and bony callus. *P* = periosteal bony callus; *E* = endosteal bony callus; *CC* = cartilaginous callus; *F* = fibrous callus; *C* = cortex; *M* = medullary cavity.

study. The callus was not abundant, but that which was present was mainly bony, an extremely small amount of cartilage being found in five of the twelve fractures. The fracture area in the sick guinea-pig showed bony, fibrous, and cartilaginous callus, holding the fragments at a 90-degree angle, and presented a histological picture much like that observed in the group whose fractured legs were not inserted into the abdominal cavity.

We observed that in the group of experimental fractures the buried forelegs were slightly movable and were heated nearly to intra-abdominal temperature. In the group of control fractures, the unburied forelegs were also held quietly and partially flexed, and were not used by the animals to bear weight. The increased temperature of the bone, dependent on the amount of muscle activity in the limb, we considered about equal in both buried and unburied legs. The cellular elements of the bone marrow are increased in the fractured extremity over that of the normal extremity. There was an increase, also, of the cellular elements of the marrow of the fractured bones inserted into the abdomen in contrast to the fractured extremities left out of the abdomen. This, it is believed, is evidence that there was an increase in the temperature of the fractured extremities within the abdominal cavity, which was not exhibited in the unburied fractured forelegs. It may be that this increased temperature, conveyed to the fractured legs which were maintained within the abdomen, contributed to the production of a firmer union, although this union was obtained in the face of greater deformity and with as much local motion at the fracture site as in the unburied legs. The specimens obtained from the buried legs exhibited a less bulky callus, more mature bony callus, and much less fibrous and cartilaginous callus than did the unburied legs that were not subjected to this increase in temperature. Bony union took place more readily, as evidenced by

FIG. 5

Photomicrograph of a specimen of foreleg obtained fourteen days after fracture and insertion into the abdominal cavity. There is a marked angulation at the fracture plane. The union is bony; no fibrous or cartilaginous callus is seen. *P* = periosteal bony callus; *E* = endosteal bony callus; *C* = cortex; *M* = medullary cavity.

roentgenographic and histological studies, in the group in which the fractured extremities were maintained within the abdomen for the duration of the experiments.

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COMPLETE MEDIAL DISLOCATION OF THE KNEE JOINT WITH DIVISION OF THE COMMON PERONEAL NERVE

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Dislocations of the knee joint, though rare, have been discussed in a number of publications in recent years. Conwell and Alldredge, Fichman, Ritter, and Mitchell have reported cases, discussed treatment, and shown favorable end results.

The following case seems worth reporting on account of the factors which appeared to have been partially responsible for the unfavorable end result.

CASE REPORT

A white, obese female, aged thirty years, was admitted to the hospital on October 11, 1937, following a fall with the left leg flexed and the right leg extended. As she fell, her body rotated to the left, but the right foot remained stationary. There was immediate pain in the right knee. Roentgenographic examination showed inward displacement of the upper end of the tibia and overlapping of a part of the head of the fibula by the medial condyle of the femur. There was no evidence of fracture. The dislocation was reduced at once under anaesthesia, and a plaster cast, extending from the hip to the toes, was applied. The following day the cast was cut and taped.

Progress was uneventful until November 16, 1937, when the patient's temperature rose slightly and she complained of sharp pain in the region of the right ankle on slight movement of the foot. The leg was warm, and the dorsalis pedis artery showed pulsations. Two days later, the foot was anaesthetic except in the instep and the lateral aspect of the little toe. The plantar surface of the foot and all the toes, with the exception of the fifth, showed slight bluish discoloration. Above the ankle on the medial side of the leg there was hyperalgesia. On November 22, the patient's temperature was septic in type. The discolored areas were much more pronounced, so amputation was decided upon and performed the same day. The patient died that evening. Autopsy was not permitted.

Pathological Examination

The specimen (Lab. No. S2501) consisted of the right leg amputated five and five-tenths centimeters above the condyles of the femur. The external appearance was similar to that already described. Dissection of the leg showed the posterior tibial artery to be thrombosed from the middle third of the leg to the ankle. The anterior tibial artery and other vessels appeared normal. The great sciatic nerve was found to divide into the tibial and common peroneal nerves at the lower border of the popliteus muscle. The common peroneal nerve, when traced out, was found to be completely severed just proximal to the origin of the musculocutaneous nerve. The torn ends were separated about two centimeters. All the ligaments of the knee joint appeared to have been torn. There was no evidence of infection or fracture, and the skin surface was not broken. Microscopic section of the proximal end of the divided common peroneal nerve showed wallerian degeneration (Weigert's stain), which seemed to be of at least four weeks' duration. Sections from the posterior tibial artery in the region of the ankle showed

FIG. 1

Roentgenogram of knee joint before reduction.

FIG. 2

Roentgenogram of knee joint immediately after reduction.

thrombosis with advanced organization but no canalization. Sections from the posterior tibial artery in the middle third of the leg showed thrombosis with early organization. There was no microscopic evidence of infection in any of the sections examined.

COMMENT

The tibial and common peroneal nerves may be separate from their origin in the sacral plexus or they may be bound together in the upper part of the thigh, thus forming the main nerves which compose the great sciatic nerve. The great sciatic nerve may divide anywhere in the thigh, but we have been unable to find any record which would indicate that it might divide as low as the inferior border of the popliteus muscle. In the case described, the common peroneal nerve coursed laterally to the region below the head of the fibula, almost at a right angle to the direction of the great sciatic nerve. Thus, when the upper end of the tibia was violently displaced inward, the common peroneal nerve was placed under much greater tension than would have occurred if the great sciatic nerve had divided in the thigh. Some of the fibers of the tibial nerve may have been injured as well, although the nerve was intact grossly. This would explain the complete anaesthesia of the foot, with the exception of the small strip on the medial side of the plantar surface, which is supplied by the long saphenous branch of the femoral nerve. The popliteal artery showed no evidence of injury, and it was strange that thrombosis of the posterior tibial artery should occur, especially since it appeared to have begun in the ankle region.

SUMMARY

In the case of complete medial dislocation of the knee joint which has been reported, the unusual feature was the complete severance of the

common peroneal nerve. The extremely low division of the great sciatic nerve appeared to be indirectly responsible in this case for the severe nerve injury. This injury through trophic disturbances may have influenced the formation of the thrombus in the posterior tibial artery.

We are indebted to the Bishop DeGoesbriand Hospital, Burlington, Vermont, for the case history, and to Dr. A. B. Lawrence whose case it was.

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EPIPHYSITIS OF THE OS CALCIS

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Epiphysitis of the os calcis, or calcaneal apophysitis, is a disease which occurs not infrequently in children between the ages of seven and one-half and seventeen years. It is seen more often in boys than in girls, the ratio being about six to one, and it is frequently bilateral.

The condition is characterized clinically by painful heels and pathologically by evidence of disturbed nutrition in the ununited calcaneal epiphysis, with rarefaction, fragmentation, and later repair with excessive calcification. The onset is insidious, with a limp and pain in the heel posteriorly. The calf muscles may ache, and the child is disinclined to walk or to run. Examination reveals tenderness posteriorly at the insertion of the tendo achillis, and signs of acute inflammation are absent. Crepitation is not elicited. There may be swelling or lateral thickening of the tendo achillis, even to the extent that the normal outline of the heel is obliterated, but this finding is inconstant. The roentgenographic appearance is typical. There is often partial or complete, and not infrequently multiple, fragmentation of the epiphysis. Areas of rarefaction produce a moth-eaten appearance. The epiphysis may be flattened, and its outline, together with that of the adjacent border of the os calcis, may be irregular. As healing occurs, the areas of rarefaction and fragmentation disappear, and a rather marked increase in density of the epiphysis develops.

Trauma, infection, nutritional disturbances, developmental abnormalities, disturbances in innervation, and endocrine imbalance have all been blamed for the condition, but a definite etiology has not yet been established. It is possible that a combination of several of these factors is sometimes responsible for the condition. It is also logical to assume that the etiological factor involved is not the same in every case. The wearing of sandals, rubber-soled shoes, or no shoes at all has been a rather constant finding. The presence of focal or other infections is not noteworthy.

Calcaneal epiphysitis is a self-limited condition, and recovery takes place when the epiphyses become completely united at about the age of seventeen years. Doubtless, many cases remain unrecognized and untreated, and spontaneous recovery without serious consequences occurs. The treatment is local and general.

The condition was first described by Sever, in 1912, who reported five cases. Between 1912 and 1934, Meyerding and Stuck found less than forty cases in the literature, and they added twenty-one cases from The Mayo Clinic. This made a total of approximately sixty-one cases reported prior to 1934. Additional cases were no doubt included in the general discussion of epiphysitis and so were overlooked. The authors

now wish to record the following two cases which have come under their observation.

CASE REPORTS

CASE 1. A boy, aged fourteen years, was examined on April 3, 1937, because of painful heels, which had developed two weeks previously following a hike over rough

FIG. 1-A

Case 1. Bilateral epiphysitis of the os calcis, evidenced by areas of rarefaction in each epiphysis.

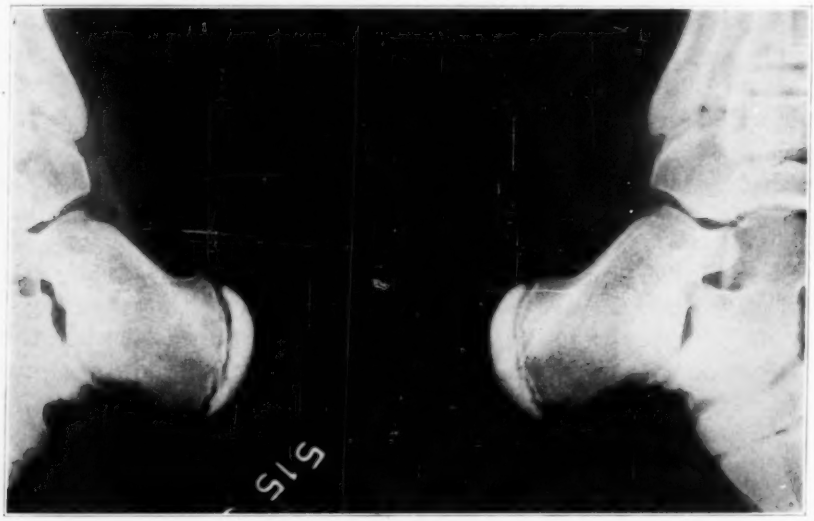

FIG. 1-B

Case 1. Six weeks later, showing an increase in density of each epiphysis, with rarefaction less marked.

FIG. 1-C

Case 1. After ten weeks the density was more marked, and areas of rarefaction had disappeared.

ground in rubber-soled shoes. The pain in the heels was aggravated by running. The past history was normal except for a transitory mild pyuria in 1932.

The patient appeared to be healthy and weighed about 100 pounds. The teeth were normal, and the tonsils had previously been removed. He walked with a slight limp, and there was moderate tenderness posteriorly in both heels. No local redness or swelling was present. The urine was normal. The leukocytes numbered 7,900, and the differential count was normal. The blood Wassermann reaction was negative. Roentgenograms of the heels (Fig. 1-A) revealed areas of rarefaction in the epiphysis of each os calcis. A diagnosis of bilateral epiphysitis of the os calcis was made.

A lift, one-fourth of an inch in height, was added to the heel of each shoe, and a rubber sponge was fitted inside each shoe. Unnecessary walking, all running, and bicycle riding were prohibited. Large doses of concentrated cod-liver oil, reinforced with vitamin D, were given daily. After six weeks, there was practically no pain or tenderness. Roentgenograms (Fig. 1-B) showed an increase in density of both epiphyses, and areas of rarefaction were less marked. One month later, density was more marked, and rarefaction was absent (Fig. 1-C). On April 1, 1939, the patient was still symptom-free.

CASE 2. A boy, aged ten years, was examined on March 25, 1937, because of painful heels of three weeks' duration. This condition was aggravated by walking, and a slight limp had developed. The patient stated that he frequently wore rubber-soled shoes and rode a bicycle. There had been attacks of epigastric discomfort and tenderness in the right lower quadrant at intervals of several years, with loss of appetite and abnormal fatigue. The tonsils had previously been removed.

Both heels were tender posteriorly, but there was no local swelling or discoloration. There was tenderness in the right lower quadrant of the abdomen. The urine was normal. The leukocytes numbered 10,000, and the differential count was normal. The blood Wassermann reaction was negative. Roentgenograms of the heels (Fig. 2-A) revealed bilateral irregularity of the epiphysis of the os calcis, with fragmentation and areas of rarefaction. A diagnosis of bilateral epiphysitis of the os calcis and chronic recurring appendicitis was made.

On March 30, 1937, a definitely infected appendix was removed. When the patient was convalescent, the heels of the shoes were elevated about one-half inch, and a rubber sponge was fitted on the inside of each heel. He was advised to walk as little as possible, and bicycle riding and running were prohibited. Cod-liver-oil concentrate, reinforced

with vitamin D, was given in very large doses. On May 28, 1937, nine weeks later, t ere was no pain in the heels, but some aching was still present in the feet. Roentgenograms of the heels (Fig. 2-B) showed less fragmentation, increased density, and less marked areas of rarefaction. On June 16, 1937, the patient stated that he had had no further pain unless he stood for long periods of time. On January 8, 1938, there was slight pain

FIG. 2-A

Case 2. Bilateral epiphysitis of the os calcis, showing bilateral irregularity of the epiphysis, with fragmentation and areas of rarefaction.

FIG. 2-B

Case 2. After nine weeks the fragmentation was less marked, the density had increased, and areas of rarefaction were less marked.

FIG. 2-C

Case 2. Nine months after treatment was started fragmentation persisted in the right epiphysis, with a marked increase in density of both epiphyses.

in the heels after an unusual amount of walking. Roentgenograms (Fig. 2-C) revealed persistent fragmentation in the right epiphysis, with marked density in both epiphyses. On December 1, 1938, the patient showed a marked gain in weight, was normally active, and only rarely complained of slight discomfort in the heels.

SUMMARY

In children, particularly in boys, between the ages of seven and one-half and seventeen years, the occurrence of painful heels should suggest the possibility of epiphysitis of the os calcis. The roentgenographic findings are characteristic,—fragmentation, rarefaction, narrowing, and irregularity in outline of the epiphysis, with later excessive calcification. The condition is self-limiting, and recovery occurs spontaneously when the epiphyses unite at about the age of seventeen years. The etiology has not been definitely established, but the rôle of trauma seems to be of some significance.

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FRACTURES OF THE CARPAL NAVICULAR

Importance of Special Roentgenography

BY ABRAHAM S. ROTHBERG, M.D., NEW YORK, N. Y.

*From the Hospital for Joint Diseases * and the Beth Israel Hospital †*

For the diagnosis of fractures of the carpal navicular, many physicians lean implicitly on the roentgenograms. However, in certain cases, the ordinary postero-anterior and lateral views may occasionally prove misleading. The following cases are presented to demonstrate the value of roentgenograms taken with the wrist in special positions, and also to emphasize the importance of evaluating clinical findings in the presence of negative films.

CASE REPORTS

Case 1. A man, aged thirty-four years, fell and injured the left arm and hand. Physical examination the next day revealed subacute pain, tenderness, and limitation of motion of the wrist and of the elbow. Roentgenographic studies showed a fracture of the proximal end of the radius, while those of the wrist were negative. Nevertheless, the extremity was immobilized in a circular plaster-of-Paris bandage, with the elbow flexed and the hand in the cock-up position. The pain at the wrist persisted. Four weeks

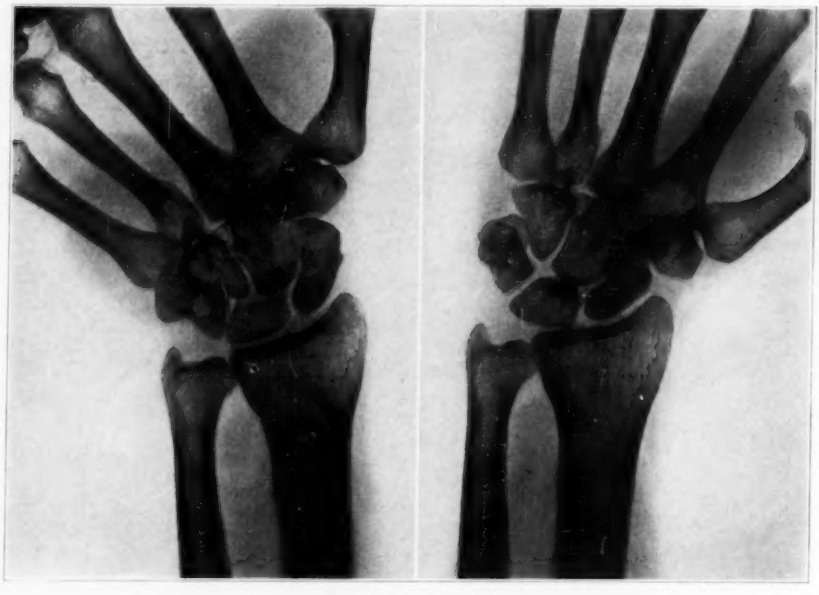

Fig. 1

Case 1. Nineteen weeks after injury. Ulnar deviation shows the fracture, but in radial deviation, the film is negative.

* Service of H. Finkelstein, M.D.
† Service of E. D. Oppenheimer, M.D.

later, the plaster was removed for the taking of roentgenograms of the wrist; another plaster was applied and removed two weeks later for further roentgenographic study. Ten weeks after the injury, roentgenograms were again taken; all the films taken up to and including these (four sets in all) were negative. Although the patient complained of some discomfort and "weak grip", he was able to return to work. Four weeks later—fourteen weeks after the injury—the roentgenograms showed a fracture of the navicular. Nineteen weeks after the injury, additional roentgenographic studies (Fig. 1) were made. In radial deviation, the film was negative, but in ulnar deviation, the line of fracture was readily seen.

CASE 2. A man, aged fifty-seven years, fell on the left hand three days before coming to the clinic. The roentgenograms (Fig. 2-A) showed a fracture of the navicular, with medial displacement of the distal fragment. The patient did not return to the clinic until two weeks later, when a circular plaster-of-Paris cast was applied. When this was removed at the end of two months, the roentgenogram (Fig. 2-B) was negative for fracture. The question arose as to whether, by some mistake, the latter film was of the other wrist. Accordingly, two exposures of each hand were made,—one with the tube directly above the wrist and the other with the tube a little to one side. On the uninvolved side, both views were essentially the same; on the left side, the displacement of the distal fragment was noted in one of the exposures.

FIG. 2-A

Case 2. Three days after fracture of the navicular with medial displacement of the distal fragment.

FIG. 2-B

Case 2. Two months after injury. With a slight shift of the x-ray tube, the roentgenogram fails to show either fracture or displacement.

DISCUSSION

In Case 1 it will be noted that the treatment was instituted and continued on the basis of clinical signs and symptoms, even though repeated roentgenograms were negative. It was only several months later, due to the osteoporosis following the immobilization, that the fracture line became evident. This fracture line was made more evident in the postero-anterior view by ulnar deviation of the hand, and was caused to disappear roentgenographically by radial deviation.

The explanation of these findings is very simple. The navicular consists of two wider portions united by a third portion. It is placed obliquely in the dorsopalmar direction; with radial deviation, the obliquity is increased, the bone is foreshortened, and the two fragments overlap to some extent. With ulnar deviation, however, the obliquity is diminished, and both parts are on the same plane; there is no overlapping, and, therefore, the line of fracture becomes more evident.

Case 2 showed another means of visualizing fractures of the carpal navicular in the postero-anterior view; a simple shift of the tube to the right or left demonstrated the fracture line that was not readily seen in the routine view.

CONCLUSIONS

In the diagnosis and treatment of fractures of the carpal navicular more emphasis should be placed on the clinical signs and symptoms than on the roentgenographic findings. A negative initial roentgenographic examination does not necessarily rule out a fracture. Several variations from the usual technique have been employed when the ordinary postero-anterior view is negative for, or suspicious of, a fracture of this bone:

1. Exposures should be made with the hand in ulnar deviation.
2. Roentgenograms should also be taken with two exposures,—one with the tube shifted a little to the right, and the other with the tube shifted to the left.

If, despite negative roentgenograms, clinical signs and symptoms exist, the part should be adequately immobilized. Sometimes, several weeks or even months later, subsequent roentgenographic examination may reveal the fracture site brought to light by the process of osteoporosis.

A SIMPLIFIED DIRECTIONAL GUIDE FOR HIP NAILING *

BY C. FRED FERCIOT, M.D., LINCOLN, NEBRASKA

Before introducing a flanged nail for internal fixation of a femoral-neck fracture, it is necessary to determine three facts: (1) the point of insertion of the pin; (2) the angle of insertion in both anteroposterior and lateral planes; and (3) the length of the nail. A simple method of determining these findings by the use of a directional guide has been employed in our Clinic since February 1938, and has greatly facilitated the operative procedure.

The directional guide consists of the range finder proper and a pin, one-eighth of an inch in diameter, to which it is clamped by means of a thumb screw. The range finder is made from stainless steel, one-sixteenth of an inch thick, and consists of a longitudinal bar, three inches long and one-fourth of an inch wide, which is shaped to a point at its proximal end. Two crossarms are attached to this bar. These are made from strips of metal, one and one-fourth and two and one-half inches long and five-eighths of an inch wide, in which are drilled holes, three-sixteenths of an inch in diameter, as shown in Figure 1. These strips are bent longitudinally along the mid-line to form right-angled bars with flanges slightly over one-fourth of an inch in width. The shorter crossarm is welded to the longitudinal bar five-eighths of an inch from its proximal end, and the longer crossarm is placed flush with the distal end of the longitudinal bar. A short set screw is placed one-eighth of an inch from the distal end of the longitudinal bar, and allows the range finder to be clamped to the holding pin when it is passed through the central hole of both crossarms parallel

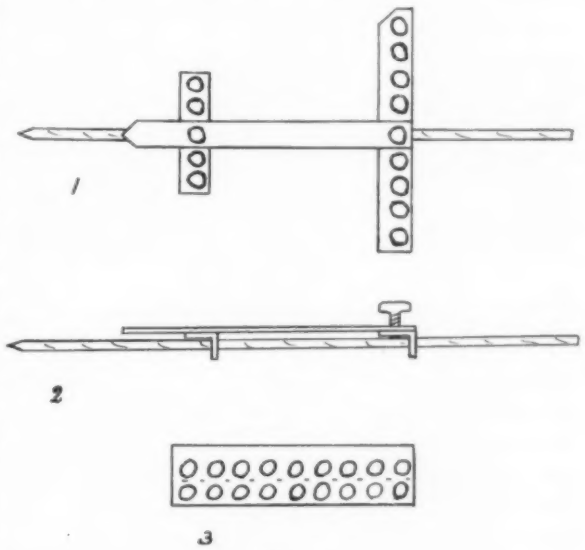

FIG. 1

Directional guide
1: Silhouette view.
2: Side view.
3: Detail of drill holes in long crossarm before it is bent to right angle along dotted line.

* From the Orthopaedic Clinic of Dr. J. E. M. Thomson and Dr. C. F. Ferciot.

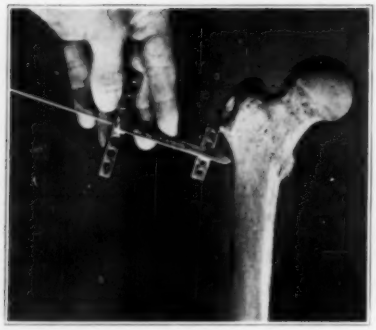

FIG. 2

Directional guide with holding pin loosely clamped by set screw, showing method of choosing point of insertion for first holding pin.

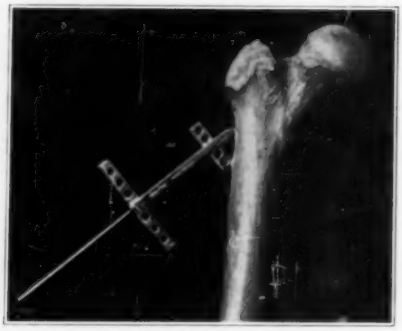

FIG. 3

The angle is chosen by rotating end of guide downward until lower end of short crossarm rests on shaft of femur below.

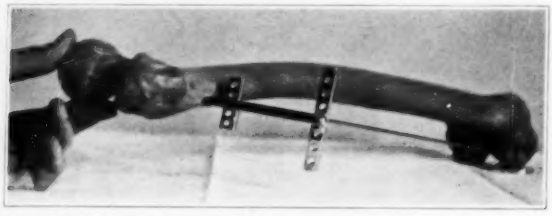

FIG. 4

Position of directional guide for lateral roentgenogram.

to the longitudinal bar. (See Figure 1.)

Following reduction, the lateral aspect of the trochanter is exposed, and the directional guide is fixed to the bone by means of the light holding pin. The point and the angle of insertion of this pin are selected by introducing the guide into the wound with the pin loosely clamped in position, placing the upper end of the short crossarm just beneath the prominent ridge on the tuberosity of the greater trochanter and allowing the point of the guide to rest on the lateral aspect of the bone (Fig. 2). The point is held stationary, and the distal portion is depressed until the opposite end of the short crossarm rests on the shaft of the femur below. The holding pin is then drilled or driven into the bone for a distance of about one inch, and the guide is clamped firmly to it (Fig. 3).

An anteroposterior film, showing the head, the neck, and the directional guide in silhouette, is exposed and developed. A long, straight pin is held before the film in the line visualized for placement of the flanged nail, and the projection of this line is readily recorded in relation to the apertures in the two arms of the directional guide. A second holding pin is placed through the apertures designated and is driven home about one inch. The first holding pin is withdrawn, and the guide is centrally placed over the second holding pin and clamped to it, so that it will appear in silhouette when the lateral roentgenogram is exposed (Fig. 4). This film is developed, and the projection of the visualized line of the flanged nail is again recorded in relation to the directional guide. When the guide wire is inserted through the indicated apertures, it will be directed in the

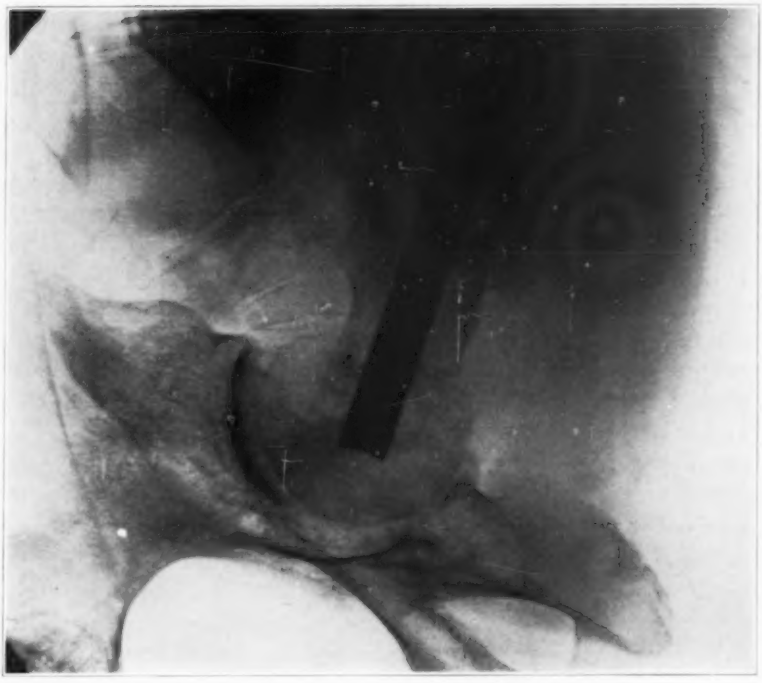

FIG. 5-B

Lateral exposure made in flexed-thigh position.

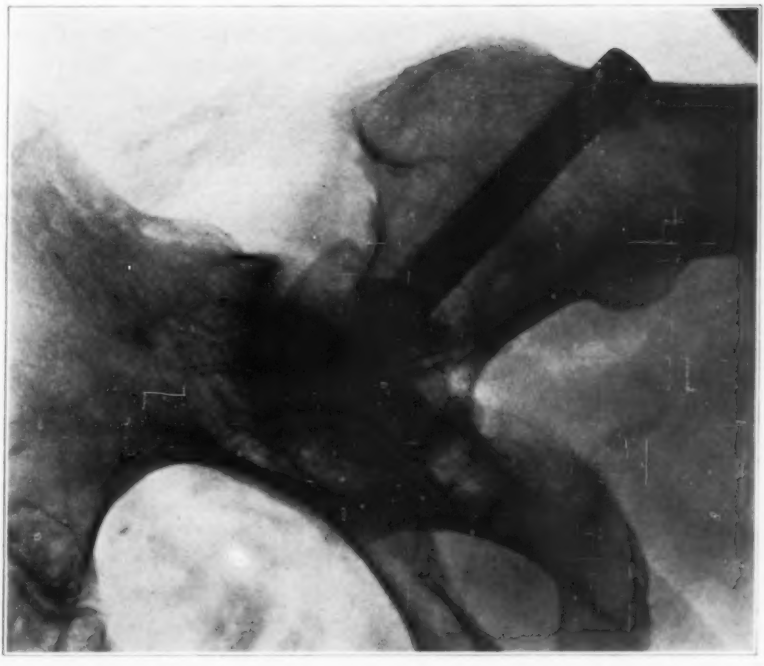

FIG. 5-A

Typical postoperative recheck at the end of one month.

visualized line of the pin both in the anteroposterior and in the lateral planes. Knowing the length (A) of the directional guide, and measuring the length (B) of its projection on the roentgenogram, and measuring the length (C) of the visualized flanged nail on the roentgenogram, the actual length (X) of the flanged nail is readily determined ($A : B :: X : C$). A chart is used to facilitate this determination. When the guide wire has been drilled up through the neck and into the capital fragment, the holding pin and the directional guide are removed; a flanged nail, of the proper length, is then driven into place, and the fragments are impacted. It has been our impression that the flanged nail gives better fixation when it is inserted as low as possible and directed upward into the capital fragment at as great an angle as is feasible. It thus gains considerable stability from its close relation to the cortical structure of the inferior femoral neck, and its increased angle partially translates the shearing stress of muscle tension and body weight into impacting forces.

Those who have had considerable experience with hip nailing may prefer to take both anteroposterior and lateral roentgenograms with the directional guide on the first holding pin, merely rotating it to appear in silhouette on each film. Indicated corrections can then be made as previously described, and the guide wire can be inserted. Thomson introduces a wire, guided by the anatomical landmarks, and places the directional guide on this wire, so that, if any change is indicated on roentgenographic examination, such change can be accurately determined by comparing the position of the first wire with that of the directional guide. In many instances the first wire is found to be suitably located, but, if not, use of the guide assures accurate placement of the next wire. While designed primarily for directing a flanged nail, this guide is readily adaptable to the multiple-pin method of fixation.

This method has been used in eleven cases, and has enabled us to choose the length of the nail and to direct fixation accurately. The simplified roentgenographic technique shortens operative time materially, thus lessening shock to the patient. While this series is too small and the follow-up period is too short to permit any conclusions as to end results, it seems reasonable to infer that a more accurate method of fixation should exert a favorable influence on bone healing.

Although no bibliography is appended, the writer wishes to acknowledge the inspiration derived from numerous articles on this subject which have appeared in the literature since Henderson first suggested the use of a guide wire in blind nailing of femoral-neck fractures.

OSSIFICATION IN THE ANTERIOR CRUCIATE LIGAMENT

BY ROBERT S. GARDEN, M.B., M.CH. ORTH., F.R.C.S.E., LIVERPOOL, ENGLAND

The publication of this case will only add still further to the already established multiplicity of sites where heterotopic bone formation has been known to occur. It is placed on record, however, since there is no previous reference in the literature to this particular condition.

The patient, a bank clerk, aged eighteen years, gave a history of having injured his left knee fourteen weeks previously during a Rugby match. He had felt a "crack" in the knee, and the joint thereafter became so painful and swollen that he was obliged to remain in bed for the ensuing week. Since then, the knee had shown a progressive instability, and he had ultimately been unable to rely on it even for ordinary walking.

Clinically, the joint appeared normal, and no local tenderness could be elicited. Manipulation revealed no localizing signs of injury to the meniscus, but there was a definite laxity of the anterior cruciate ligament, as compared with that of the other side.

Roentgenographic examination revealed a curious fenestrated appearance, as though the tibial spines had been bridged across by an abnormal bone shadow. In the lateral view, this shadow was situated in the center of the joint. The femur, the patella, and the tibia were normal.

Speculation as to the nature of this abnormality, together with the fact that the patient's complaints were sufficiently definite to warrant active surgical interference, prompted an exploration of the joint. This was carried out through a two-inch anteromedial incision. A small, hard plaque was immediately apparent in the tibial attachment of the anterior cruciate ligament. This was dissected out, and, since the integrity of the ligament itself did not appear to have been disturbed, the joint was closed. Histological examination of the nodule showed that it consisted of fibrous tissue, in which a well-marked osteoblastic reaction had taken place.

When the patient was last seen, six months after operation, the knee was normal in every way, apart from a slight persisting laxity of the anterior cruciate ligament, which did not appear to impede the joint function.

FIG. 1

Anteroposterior roentgenogram, showing abnormal ossification in anterior cruciate ligament.

This heterotopic bone formation was doubtless of the same nature as that found elsewhere, and, therefore, it seems probable that the original injury involved the anterior cruciate ligament, resulting in localized hemorrhage with subsequent ossification therein.

Thanks are due to Mr. T. P. McMurray for permission to publish these case notes.

COXA PLANA

Report of Two Bilateral Cases in Brothers

BY WALTER H. HAGEN, M.D., EAST ORANGE, NEW JERSEY

From the New Jersey Orthopaedic Hospital and Dispensary, Orange

The literature abounds in descriptions and theories as to the cause of coxa plana. Therefore, this paper will be confined to the report of two cases of bilateral coxa plana in brothers, and it is presented with the hope that it may contribute to an eventual solution of this problem.

Reports of similar cases are few, although it has long been recognized that this condition may develop in several members of the same family. Calvé has described the condition in a brother and sister; Eden, in a father and son; Müller, in a father and daughter; Brandes and Perthes, in several members of the same family. The most interesting reports have been by Brill, who traced the condition through six generations in one family, and Kaiser, whose long and well-illustrated account of the disease in a large number of cases through four generations is an outstanding contribution to the etiological phase of coxa plana.

Fig. 1

Patient J. E. Roentgenogram (No. 11502) taken on July 19, 1939, demonstrating the extent of the lesion.

The patients whose cases follow are of Italian descent, and have been under observation in the Clinic of the New Jersey Orthopaedic Hospital and Dispensary for three and seven years. One has undergone surgical procedures; the other has refused all manner of treatment, but is occasionally checked-up and x-rayed.

CASE REPORTS

CASE 1. J. E. (No. 31492), aged thirty-six years, first came to the Clinic in July 1932, with a complaint of pain in the right hip of several months' duration, as well as of a limp. Past history of disease was denied, and the patient could recall no trauma.

Examination revealed a right thoracic, left lumbar scoliosis and a right hip in which flexion was possible to about 45 degrees; rotation and abduction were almost completely limited. Roentgenograms demonstrated an old bilateral coxa plana with marked superimposed osteo-arthritic changes.

Observation was advised, as well as the use of a belt above the trochanters. The patient did not return until December 22, 1937, after his brother had been treated in the Clinic and a similar condition had been found. At this time another roentgenogram revealed some progression of the osteo-arthritic changes in the hip joints. In the interval, bilateral arthroplasties were advised elsewhere, but were refused.

During the past year, exercises and physiotherapy have somewhat improved the patient's gait and range of motion. He walks with a waddle, but has been able to discard his crutches, although he uses one cane, with which he can walk several blocks at a time with ease. This modest improvement has made him unwilling to submit to any type of surgery.

FIG. 2

Patient A. E. Roentgenogram (No. 16613), taken on June 29, 1939, demonstrating the lesion. This patient also has not been treated by any surgical attack on the joint.

CASE 2. A. E. (No. 44228), aged thirty-four years, first came to the Clinic on October 30, 1937, with a history of pain over the anterior aspect of the left hip of seven or eight years' duration, which radiated down the anterior aspect of the left thigh. The patient also complained of marked stiffness of both hips. The symptoms had been progressive and were aggravated by much walking.

On examination, the hips were found to be stable, but motion in them was markedly limited, with 15 degrees of abduction, 5 degrees of adduction, and 10 degrees of external and internal rotation. A 10-degree flexion deformity was also present in each hip. Roentgenograms revealed a bilateral osteo-arthritis of the hip, with changes characteristic of old coxa plana.

Bilateral tenotomy of the adductors was performed on December 10, 1937, and the patient was placed in long leg casts with a crossbar to maintain abduction. After three weeks, physiotherapy and exercises were instituted, and the patient was discharged to the Clinic soon after.

Over a period of months, with exercises, manipulations, and physiotherapy, this patient improved in gait. He had less pain than formerly, although motion was still quite restricted. In January 1939, flexion of 75 degrees was present, as compared to 45 degrees before treatment, and there was from 10 to 15 degrees of abduction. He was able to walk several blocks without the use of cane or crutches, and without pain. On his latest examination on July 10, 1939, he was without pain; he could flex both hips 90 degrees and abduct them 15 degrees, and had only a very slight waddle.

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FRACTURE OF AN ARTICULAR PROCESS

BY MAURICE H. HERZMARK, M.D., NEW YORK, N. Y.

This case is of interest because the first treatment was rendered by a practitioner, who overlooked a fracture of the articular process despite roentgenographic demonstration and proceeded with manipulations, which probably displaced the fragment and increased the disability.

J. H., a white male, aged twenty, while lifting a heavy rock in August 1937, felt a sudden pain in his back and was unable to continue his work. Roentgenograms of the lumbar spine were said to show no fracture, and a series of manipulations were given, which resulted in an increase of the pain and disability. The patient then received further advice and was given massage and applications of heat, with no improvement. After nine months of such treatment, a physician was consulted, and a roentgenogram of the lower spine was made. This showed an unusual condition, and the patient was referred to the author for examination.

Examination of the patient showed that the trunk was symmetrical and the spine was of normal configuration. The motion of the spine was unrestricted, but extremes of motion caused the patient to complain of pain referred to the left lower lumbar spine. Lifting even light objects was difficult, because of pain, and extending the spine from the flexed position was done guardedly, because of pain referred always to the left lower lumbar region. Pressure in this region caused pain localized to an area over the left fourth lumbar vertebra. Motion of the extended legs in the recumbent position caused no distress.

Examination of the roentgenogram which was made by the family physician showed a fracture of the left superior articular process of the fifth lumbar vertebra with upward displacement of the fragment.

Because of persistent pain unrelieved by massage and other forms of conservative therapy and because of the belief that the pain was caused by the loose fragment, a spine fusion of the affected region was considered the quickest and best means of eliminating the disabling condition.

Accordingly, the patient was admitted to the Hospital for Joint Diseases on July 25, 1938, and, on the following day, the region of the left superior articular process was explored. The fragment was found to be loose and was easily moved with forceps. The fibrous tissue was curetted away, and bone chips from the laminae and the spinous process were laid across the fracture site. The articular cartilage was removed, and bone chips were deposited in the area. The wound was closed in layers in accordance with the usual technique for spine fusions.

Convalescence was uneventful, and, on August 8, 1938, with the patient lying on a Goldthwait frame, a plaster-of-Paris jacket was applied from the nipple line to the base of the spine. Wearing his jacket, the patient was discharged from the Hospital on August 9, 1938, in good condition and free from pain.

After four weeks the plaster jacket was removed, and examination revealed a satisfactory range of painless motion of the spine. A lumbosacral belt was applied, and physiotherapy was prescribed.

After seven months, examination showed a satisfactory range of painless motion, and the patient returned to work.

This case of fracture of an articular process illustrates how disability may be unduly prolonged and a spine fusion necessitated because of failure on the part of the individual who first sees the patient to recognize a fracture.

MOVABLE TRACTION CARRIER

An Apparatus for Combining Traction with Motion at the Hip

BY ALVIN M. ARKIN, M.D., BROOKLYN, NEW YORK

From the Orthopaedic Service of the State University of Iowa Hospitals, Iowa City*

In the treatment of conditions about the hip joint, there is frequent need of a splint affording a combination of traction and motion at the hip. This is particularly true in mobilization of the joint after trauma or operative procedures. Traction which follows in the long axis of the limb as it is moved is an important factor in diminishing muscle spasm and in lessening pain. Also, in arthroplasties, it relieves the grinding pressure on the fascia lata covering the articular surfaces. For these purposes the splint shown in the illustrations was devised.

The essential feature is a simple overhead frame, which carries the traction. Instead of being fixed to the bed, however, this frame is suspended from another frame, which is attached to the bed, by a joint placed directly above the involved hip. The joint is so constructed as to permit motion in flexion, extension, abduction, and adduction. Since the joint is directly over the hip joint, the limb remains parallel with the frame in carrying out these motions.

The handle enables the patient passively to put his leg through the range of motion as often as is wished. Passive abduction and adduction would not be possible by the use of the handle, if the movable frame were

FIG. 1

Lateral view of the frame.

* Arthur Steindler, M.D., Director.

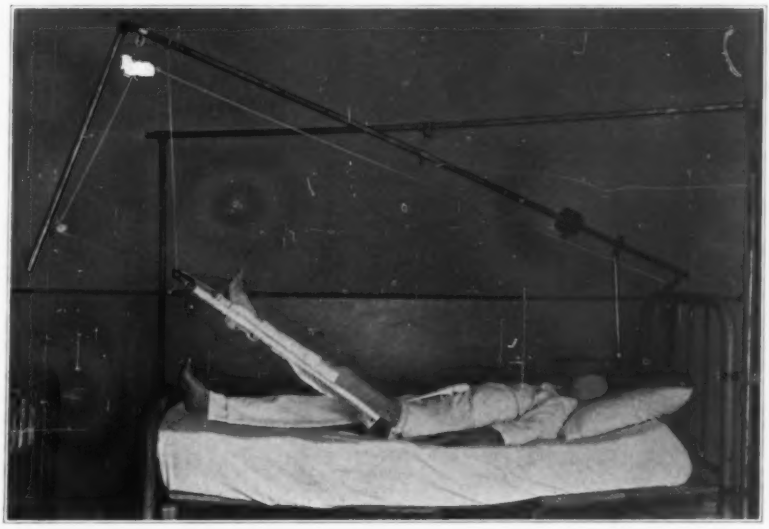

FIG. 2

Lateral view, demonstrating the range of flexion.

free to rotate about its long axis. Consequently, the joint is not a universal joint, but permits motion in two planes only. The movable counterweight may be so adjusted as to balance the weight of the leg, and active motion is then possible with very little effort and without use of the handle.

The fixed frame is fastened to the bed diagonally, from the foot of the bed on the side of the sound hip to the head of the bed on the side of the involved hip. Since the movable carrier is just as long as the fixed frame, it cannot be adducted past it, but there is a sufficient range of adduction for all practical purposes.

FIG. 3

Range of flexion and abduction, seen from the foot of the bed.

The entire frame is made of ordinary one-inch pipe (outside diameter), the length of the fixed vertical arms being five feet. The fixed

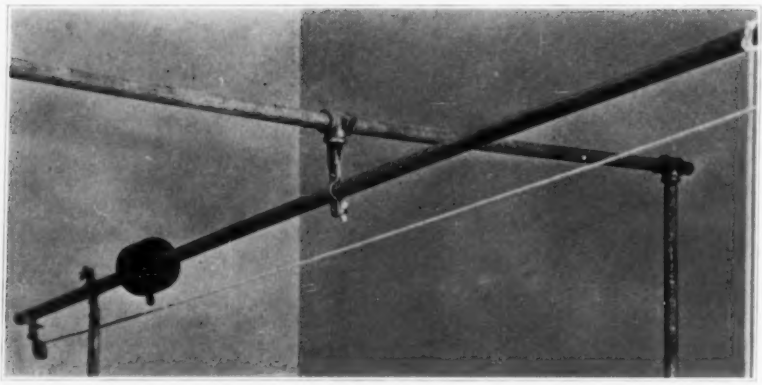

FIG. 4

Close-up view of swivel joint.

horizontal bar is eight feet long. The movable carrier has a vertical foot piece, which is three feet long. The length of the horizontal beam is eight feet, and that of the handle, eighteen inches. The fixed horizontal bar may be adjusted to slide through the fixed uprights, and the swivel joint, which carries the whole movable traction frame, may be slid up and down on the fixed horizontal bar. The handle is also adjustable to fit the individual case. The whole apparatus may be taken apart, and it is interchangeable for either hip. The ordinary hospital bed may be employed, but it is better to use a bed in which the head and foot piece are flush with the mattress, as this permits a greater range of flexion.

In the illustrations, the patient demonstrates the range of motion possible four weeks after an arthroplasty with interposition of fascia lata for ankylosis of the hip. The apparatus is being used in conjunction with a Thomas splint, which is suspended by a cord from the lower end of the movable carrier. Traction of six pounds and a six-pound counterweight are being used. Various other types of traction that may be set up on the movable carrier will suggest themselves.

Two of these traction carriers are in use at present at the Children's Hospital, Iowa City, with satisfactory results.

STENOSING TENDOVAGINITIS AT THE RADIAL STYLOID PROCESS

BY J. E. McDONALD, M.D., F.A.C.S., AND FRANK A. STUART, M.D., TULSA, OKLAHOMA

Stenosing tendovaginitis at the radial styloid process was first described by de Quervain in 1895 and later by Hoffman in 1898. De Quervain described it as a narrowing of that part of the tendon sheath lying over the styloid process of the radius through which the tendons of the extensor pollicis brevis and abductor pollicis longus traverse. This unusual condition has characteristic symptoms and physical findings, and usually occurs in individuals whose occupations require a repetition of certain movements.

CASE REPORT

H. A., female, aged twenty-two, married, whose occupation is folding clothes as they come off a mangle in a laundry, was examined on April 3, 1938, because of pain and swelling in the left wrist. She stated that on March 30, 1938, while at work, she had noticed acute pain in the left wrist at the base of the thumb. On inspection, swelling in the region of the styloid process of the radius was noticed. Palpation at the styloid process produced pain. The thumb was then placed within the palm of the hand, and the fingers were flexed over it. Next, the entire hand was sharply forced into ulnar abduction, and exquisite localized pain was felt in the region of the styloid process. The thumb was then released, but the fingers were kept flexed, and the hand was again forced into ulnar abduction; this time, however, no pain was experienced at the base of the thumb. After this manoeuver had been carried out, we felt certain that we were dealing with a stenosing tendovaginitis at the radial styloid process. The general physical examination revealed no other abnormalities. The Wassermann reaction was negative. There is no tuberculosis in the family. Roentgenographic examination of the left wrist was negative.

Treatment

It was decided to carry out the conservative method of treatment first, so a plaster-of-Paris cast was applied with the thumb in wide abduction for a period of several weeks. The cast was then bivalved, and the patient was given diathermy. A mild degree of swelling at the radial styloid process persisted, and the pain, while less acute, was still present.

On April 22, 1938, under general anaesthesia, a linear incision was made over the styloid process of the radius, exposing the extensor tendons of the thumb. The tendon sheath was somewhat thickened, but no fusiform swelling through the tendon sheath could be detected when the thumb was moved. The tendon sheath was then opened, and immediately a fibrinous exudate was noted; this was attached to the sheath as well as to the tendon. A section of the tendon sheath was sent to the pathological laboratory for examination. The wound was loosely closed. The pathological report was "inflammatory tissue".

Postoperative Course

Within twenty-four hours after surgery the patient could move her thumb freely without experiencing the old type of pain. She remained in the hospital three days and was officially dismissed on June 8, 1938, at which time she had complete relief from pain. There was, however, a slight keloid formation in the operative wound. One year later, the patient had had no recurrence of pain or other disability.

AN ATTACHMENT TO THE HAWLEY TABLE FOR THE TREATMENT OF FRACTURES OF THE LUMBAR, THORACIC, AND CERVICAL SPINE *

BY RALPH D. PADULA, M.D., NORWALK, CONNECTICUT

About a year ago, the writer described a litter for handling fractures of the spine.[1] Recently he has completed a device, similar in principle, to be used as an attachment to the Hawley table. This was done at the request of Dr. Hawley, who has contributed some helpful suggestions, particularly that part which has to do with treating fractures and dislocations of the neck.

The apparatus, as shown in the illustrations, has been tested, used, and found to be satisfactory. It is not complicated or difficult to operate. It spares the patient much handling and saves the surgeon and those helping him both time and effort.

The felt pads shown in the photographs are fitted to the thin sheet-aluminum slings, so that the felt stays in place and the slings slip out after application of the plaster cast. Felt splits easily, so shallow cross cuts are made with a razor blade, and a table knife is used to split the felt, which is threaded on the strips of aluminum, as seen in the photographs. The apparatus affords effective exposure for application of a plaster cast, including head, neck, shoulders, and thorax. The head and chin bands slide out, leaving the felt in the cast. Traction by Crutchfield tongs can be used in place of chin traction.

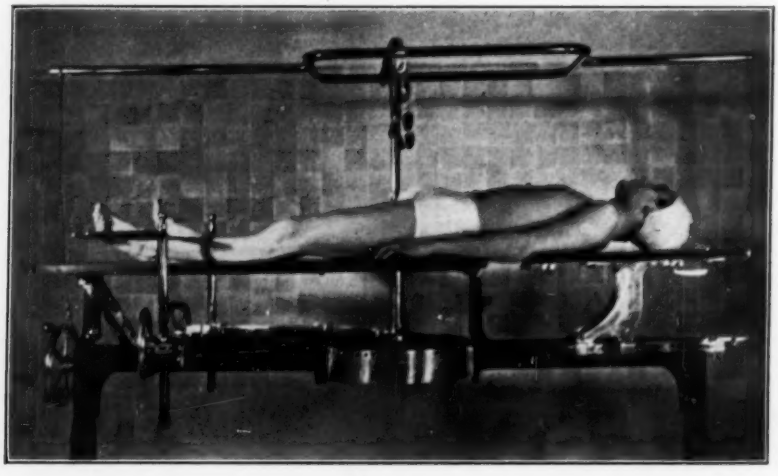

FIG. 1

Showing patient on table before reduction and immobilization of fracture of lumbar, thoracic, or cervical spine.

* Presented at the meeting of the Orthopaedic Section of the New York Academy of Medicine, April 21, 1939.

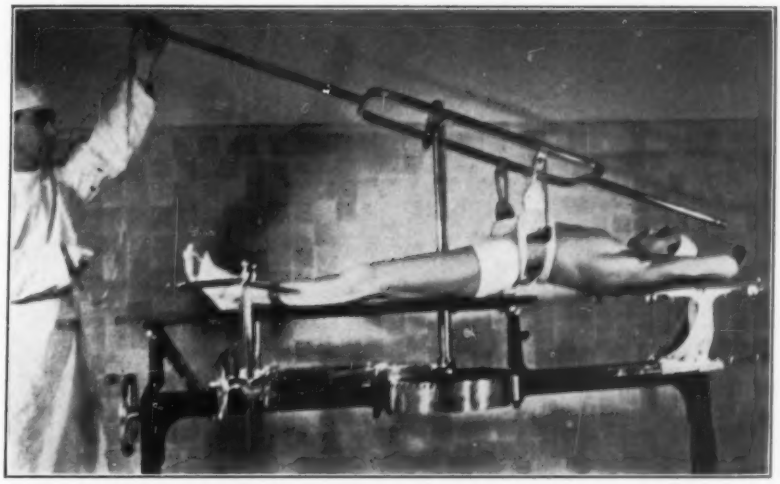

FIG. 2

First step in reduction of lumbar fracture. Sling under site of fracture and frame tilted.

It will be noticed that a distinction is made between fractures in the lumbar, thoracic, and cervical regions, and that treatment differs somewhat in each, although it is subject to variation to meet different needs or wishes of the surgeon.

In lumbar fractures, the sling is placed posterior to the fracture, and the extension curve extends from the hips to the upper thoracic vertebrae. The legs are extended on the pelvis, and the Y ligaments are shortened. This fixes and extends the sacrum on the fifth lumbar vertebra, with the maximum curve in the region of the fracture.

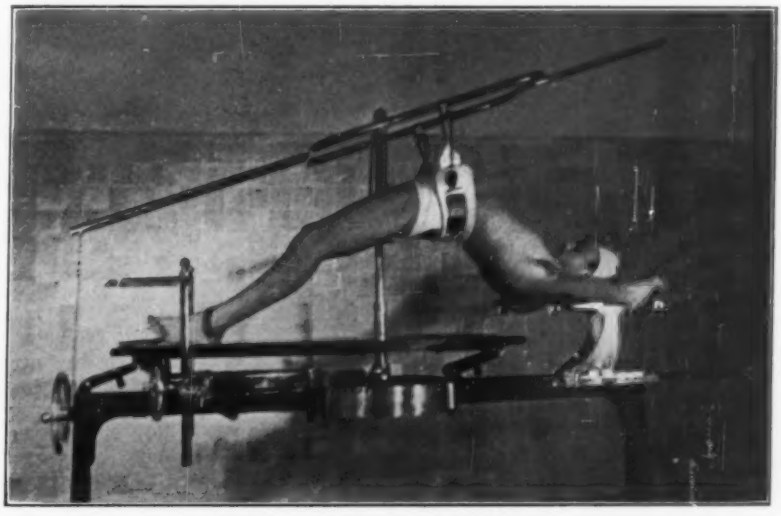

FIG. 3

Hyperextension effected by raising sling. Sacral rest forced up under sacrum and locked. Feet lowered to extend hips on pelvis.

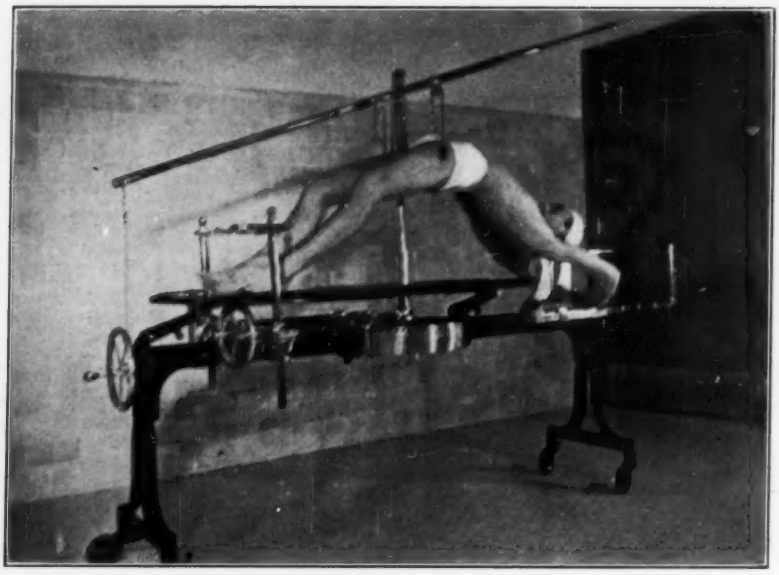

FIG. 4

Sling removed. Hyperextension maintained by sacral rest. Unobstructed exposure for roentgenographic check of degree of reduction. Hyperextension increased or decreased by raising or lowering sacral rest. Extension of hips shortens Y ligaments, fixes pelvis, and extends sacrum on fifth lumbar vertebra. Hyperextension curve extends from pelvis to upper thoracic vertebrae, with maximum curve in lumbar region. Ample exposure for application of plaster with access to back.

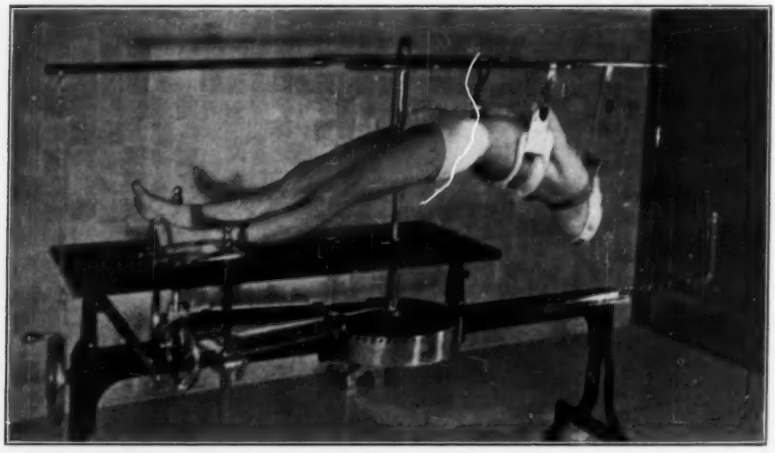

FIG. 5

Position and suspension for treatment of fractures of thoracic vertebrae. Sling under site of fracture. Chest support removed. Head supported by adjustable aluminum sling. Hyperextension curve extends from sacrum to occiput, with maximum curve in region of fracture.

In thoracic fractures, the sling is placed posterior to the fracture, and the extension curve includes the cervical spine. This increases the exten-

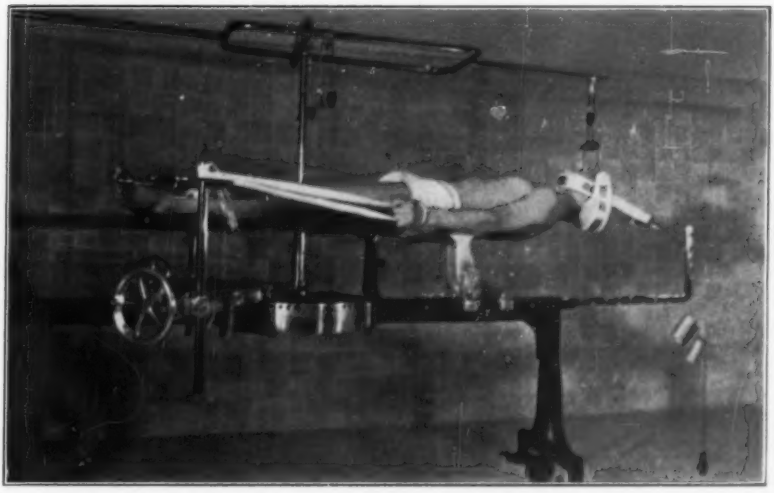

FIG. 6

Position for treatment of fracture and dislocation of cervical spine. Head supported by sling. Extension of neck regulated by raising or lowering head sling. Traction by padded aluminum sling under chin. When the back of the head is firmly supported, strong and effective chin traction is possible. About twenty pounds was used in this fracture. Counter-traction by muslin bandage from wrists to leg bars.

sion curve of that section of the spine to which the thoracic box is attached, and which is not as flexible as the spine above or below. The hyperextension curve thus extends from the occiput to the sacrum, with the maximum curve at the site of fracture.

In cervical fractures, traction, with or without extension, is used, together with counter-traction on the arms.

The advantage to the patient is that he is in the supine position at all times, and the only movement to which he is subjected is slow, gradual extension of the spine. The degree of extension is subject to control and to variation with little effort. There is free exposure for roentgenographic examination to determine the effect and degree of extension and for the application of plaster.

The writer is more and more coming to believe in the advisability of early reduction and immobilization of fractures of the spine, except in cases of shock, severe cord injury, and multiple injuries. Such practice is in line with the treatment followed in other fractures. It gives early mental relief. It lessens shock. It relieves muscle spasm and muscle splinting, not only of the back muscles, but also of the abdominal muscles. It tends to lessen hemorrhage, to check oozing from the bone fragments, and to promote clotting.

Delay unnecessarily prolongs and aggravates the pain incident to the fracture, mental apprehension, fear of movement and handling by nurses, and the anxiety of waiting until permanently immobilized and protected by plaster encasement. So many fractures of the spine are of the simple

compression type without cord injury, except pressure from hemorrhage, which disappears of itself. It is a simple matter to cut a large window over the abdomen, similar to that in the old Calot jacket, in anticipation of ileus, and, if distention develops, the cast may be split above and below, which affects little the fixation or extension of the spine.

With the table and apparatus here described, it is possible to x-ray, to diagnose, to reduce, and to immobilize a fracture of the spine upon the arrival of the patient at the hospital. The patient is brought on a wheel-stretcher from the accident room and placed on the table. He is not disturbed or moved again until ready to be put in bed, secure in plaster encasement with the fracture reduced.

1. Padula, R. D.: Spinal Hyperextension Litter. J. Bone and Joint Surg., XX, 507, Apr. 1938.

A NEW DEVICE FOR FACILITATING THE TAKING OF ROENTGENOGRAMS WHEN PERFORMING THE EXTRA-ARTICULAR METHOD OF INTERNAL FIXATION IN FRACTURES OF THE FEMORAL NECK

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Lieutenant Colonel, Medical Corps, U. S. Army

AND LEONARD T. PETERSON, M.D., WASHINGTON, D. C.
Captain, Medical Corps, U. S. Army

From the Orthopaedic Section, Walter Reed General Hospital

The device shown in the accompanying illustrations was conceived and developed in the Orthopaedic Section at Walter Reed General Hospital to facilitate the taking of anteroposterior and lateral roentgenograms as a guide to reduction and the accurate placing of the Smith-Petersen nail when practising internal fixation in fractures of the neck of the femur. We employ the extra-articular method of nailing, using Kirschner wires as a guide over which the nail is driven. In actual practice this requires a minimum of four exposures during the procedure,—two in the anteroposterior plane and two in the lateral plane. We early discovered that it was impracticable in these cases to insert a cassette between the patient and the pelvic rest each time that an anteroposterior roentgenogram was taken. In heavy individuals especially, this was very difficult and involved the possible hazard of disturbing alignment of the fragments after reduction had been accomplished. Furthermore, it required lifting the patient and possible disturbance of the sterile draping each time that it was attempted.

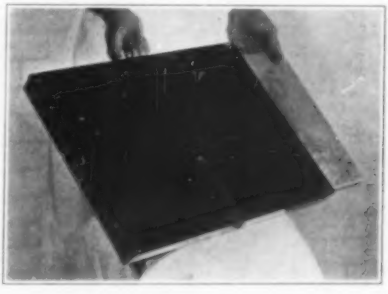


FIG. 1

Close-up view of cassette holder. Note cassette in place in left compartment. One of the operator's hands is holding the screw-bolt which bisects the device and engages a threaded sleeve in the pelvic post of the fracture table. The under surface of the tunnel rests upon the pelvic seat of the table.

We accordingly designed the tunnel or film changer herein illustrated. This device has for us completely solved the problem of obtaining satisfactory roentgenograms with no disturbance of the patient and with a minimum of effort during this procedure. It is not only of inestimable value in taking the anteroposterior view, but it is decidedly helpful as a rest upon which to support the cassette in taking the lateral view. This feature is well portrayed in Figure 4.

Another advantage in the use of this device is that it affords a broad, firm support upon which the patient rests during the reduction of the fracture and subsequent procedures. We feel that this factor is of incal-

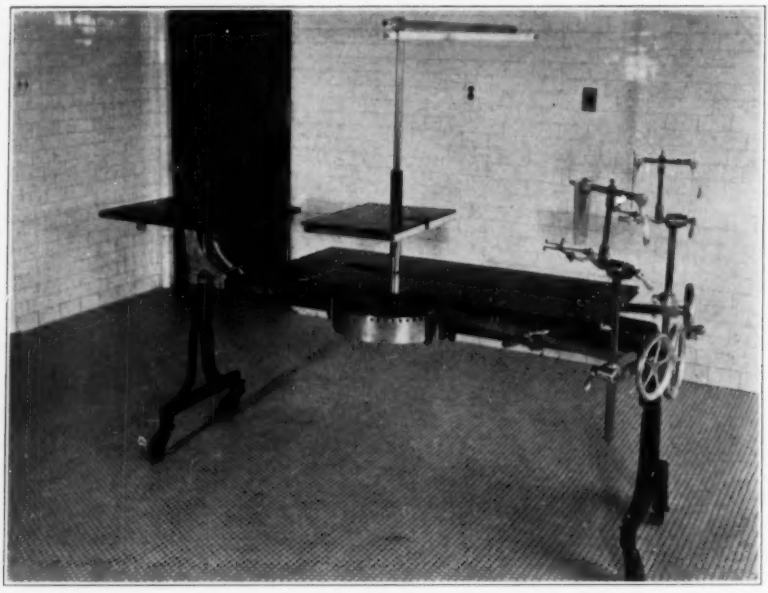


FIG. 2

Showing cassette holder in place on fracture table. Note the broad, firm support upon which the patient rests during reduction of the fracture and subsequent operative procedures.

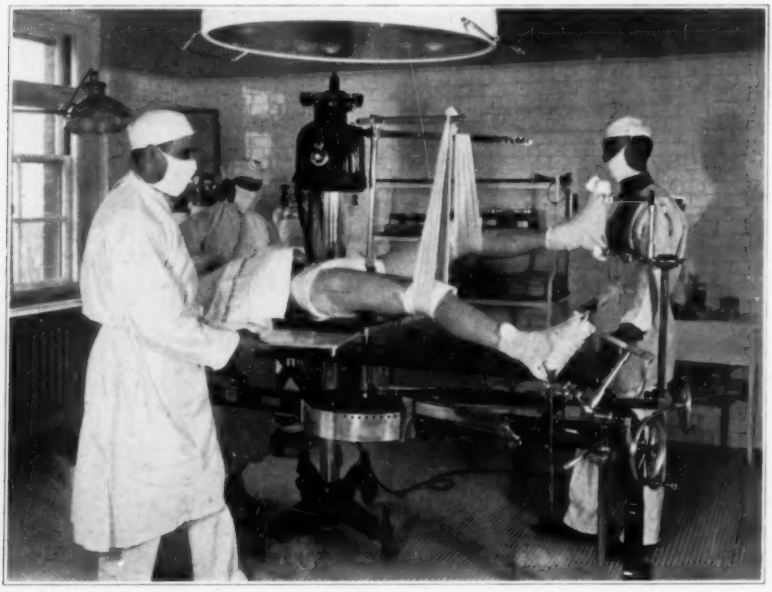


FIG. 3

The fracture has been reduced by the Leadbetter technique. The cassette is being introduced in the tunnel preparatory to the taking of an anteroposterior film for verification of the position of the fragments.

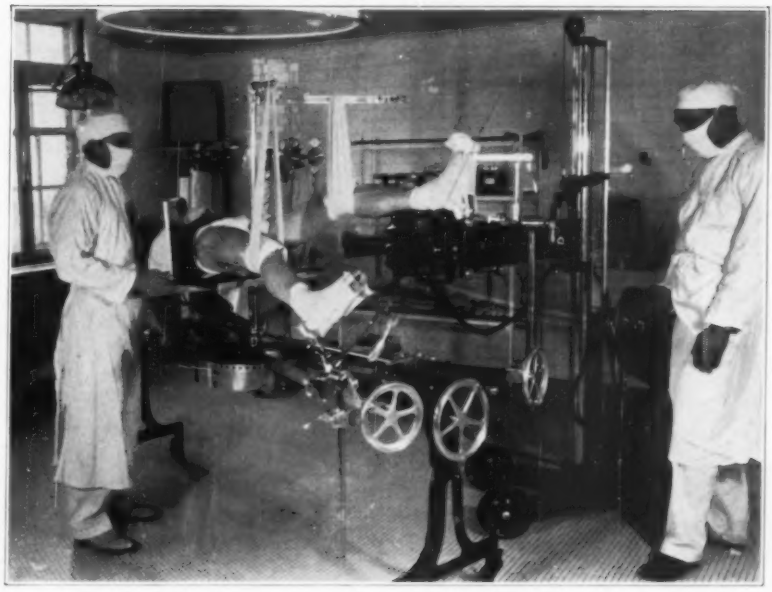


FIG. 4

Illustrating the set-up for making the lateral view. The cassette is resting upon the upper surface of the tunnel and is being supported in this position during the exposure.

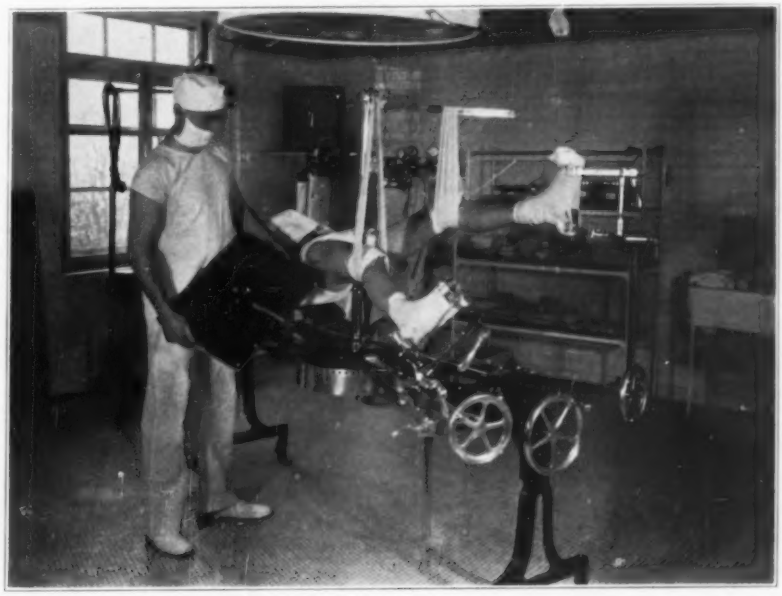


FIG. 5

Showing the cassette holder removed to permit the application of a plaster spica.

culable value and has a decided advantage over the standard pelvic rests which form a part of all orthopaedic fracture tables. These rests are all necessarily relatively small and equally uncomfortable, and it is almost impossible, especially in the case of large individuals, to maintain a constant position for any considerable length of time. We do not at present employ plaster immobilization following operation in these cases, but the cassette holder is so designed that should this be necessary or desirable it is readily removed at the conclusion of the operation by releasing the engaging bolt and sliding it out from under the patient, allowing him to rest on the regular pelvic support during the application of plaster.

We also routinely make use of this device in checking the fracture site for position and callus in both planes during the convalescent period. A portable roentgen-ray unit is used, as at the time of operation.

The under surface of the tunnel is of cast aluminum, the upper of polished bakelite, thus harmonizing with the metal and wooden parts of the fracture table. When in use, it rests upon the pelvic seat of the table, a central groove or slot encompassing the pelvic post. Fixation is provided for by a long screw-bolt, which bisects the device perpendicularly and engages a threaded sleeve incorporated in the pelvic post. A thumb screw at the proximal edge provides the desired tension. The tunnel may be entered from both sides, so that it may be used for either hip.

Detailed working procedures are purposely omitted. The photographs with the accompanying legends are self-explanatory.

A SIMPLE LEG ELEVATOR INCORPORATED IN A PLASTER CAST

BY SIDNEY SIDEMAN, M.D., CHICAGO, ILLINOIS

It is often desirable to maintain an elevated position of a limb that has been encased in plaster-of-Paris. Usually, elevation is a postoperative requirement. Pillows and sandbags are generally used for this purpose, but the author has found them entirely unsatisfactory, because of the necessity for frequent adjustment and constant attention to maintain the proper elevation. The following method obviates the necessity of using pillows and sandbags and provides continuous, permanent

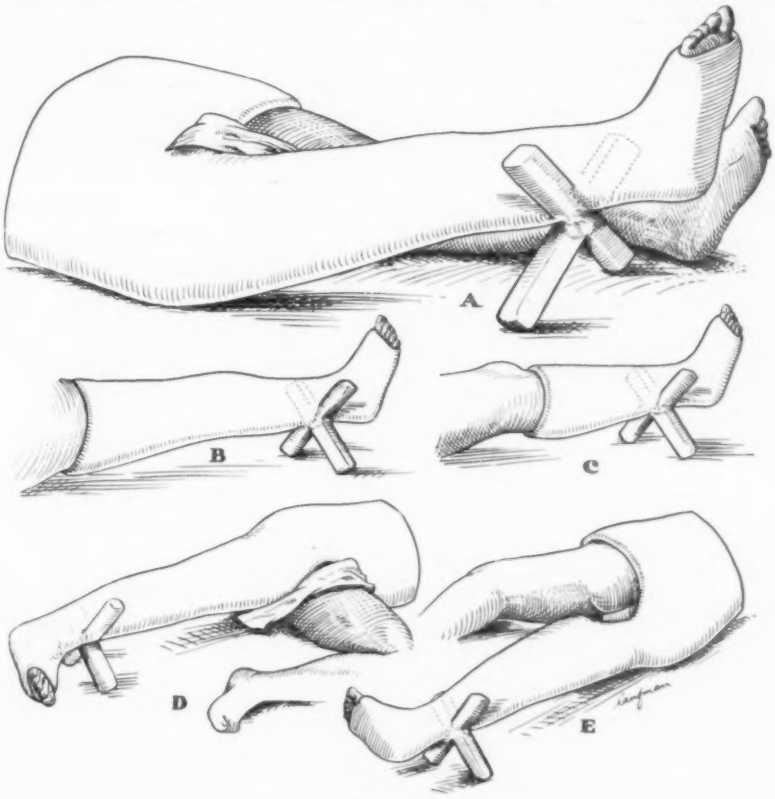


FIG. 1

elevation and rotary stabilization of a limb, regardless of whether the patient is supine or lying on either side.

TECHNIQUE

Two pieces of wood, about twelve inches long and one inch wide and deep, are nailed, riveted, or held together, so as to form a cross. By adjusting the cross, one may obtain a wide base of support or a narrow

one. The wide base will provide a moderate degree of elevation, and the narrow base will give a higher degree of elevation. For ordinary purposes, a perfect right-angle cross will provide from 15 to 20 degrees of elevation. This cross of wood is wrapped in a plaster bandage. After the cast has set, it is placed into the upper angle of the cross at a point about one and one-half inches above the ankle. The cross is then secured to the cast by means of a few additional turns of plaster bandage.

ADVANTAGES

The method has been used in connection with hip spicas, where the cast is applied with the limb in 15 or 20 degrees of flexion, with long leg casts, and with short leg casts. It has been employed in cases where the knees have been flexed or extended. In obtaining dependent drainage for infections, especially osteomyelitis of the tibia and of the femur, it has been unusually efficacious. In one case of acute osteomyelitis of the lower femoral epiphysis, surgical drainage of the abscess was established through the metaphyseal approach. The limb was placed in a hip spica in 20 degrees of elevation by means of this method. Dependent drainage was thereby established away from the joint, and the knee escaped secondary involvement. In addition to maintaining elevation and rotary stabilization, the apparatus affords an improved method for drying extremity casts. It permits circulation of air, because of the free space between cast and bedding. It eliminates the soggy, damp cast that results unless the patient is frequently turned, which is often undesirable after an operation. Heel pressure as a postoperative complication is also avoided.

A NEW INSTRUMENT FOR PASSING THE PARHAM BAND

BY HARRY B. MACEY, M.D., ROCHESTER, MINNESOTA

From the Section on Orthopaedic Surgery, The Mayo Clinic

The difficulty frequently encountered in encircling bone with a Parham band is well known to those who employ these bands in the treatment of fractures.

Many instruments have been devised to facilitate the passage of these bands around the bone; however, because of the difficulty which occurs at times in their use, a new instrument has been invented, which prevents detachment of the band and entanglement in muscle or periosteum.

The instrument is constructed as a flattened tube with a bluntly pointed, detachable cap. Its over-all length is twelve and one-fourth inches; its actual length, ten and one-fourth inches. The over-all length of the housing is three and three-fourths inches. The housing describes an arc of 180 degrees with a radius of three-fourths of an inch. The handle is so constructed that there is an angle of 17 degrees in its mid-portion. The housing is nine-sixteenths of an inch wide, and it contains a space, one-sixteenth of an inch wide, for the Parham band. The over-all thickness is nine sixty-fourths of an inch.

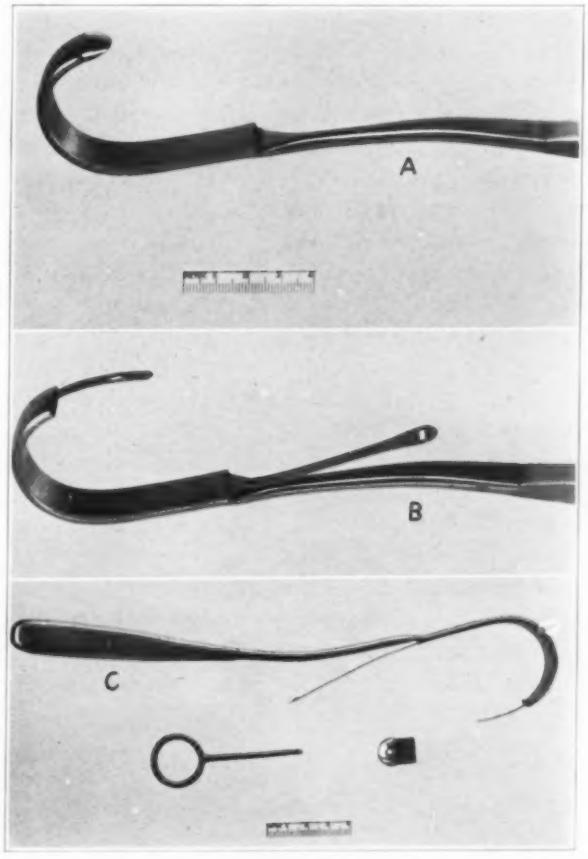


FIG. 1

A: Complete instrument with cap in place;

B: Cap removed and Parham band inserted;

C: Complete instrument with Parham band inserted, and (below) ring for removal of cap.

A NEW ELECTRIC POWER UNIT FOR DRILLING AND SAWING BONE

BY WILBUR J. COX, M.D., SAN FRANCISCO, CALIFORNIA

From the Department of Surgery, Division of Orthopaedic Surgery, University of California Medical School

For many years there has been need for improvement in the present electric drills and saws used in orthopaedic reconstruction surgery. In using these drills and saws, the writer has experienced many difficulties, — for example: (1) contamination of the operative field, due to the leakage of oil from the drive-shaft of the motor; (2) contamination of the sterile outside shells by inexperienced nurses while assembling the power unit; (3) short circuiting of the electroconducting cord, causing a delay in the operation; and (4) frequent repair of power cables, due to mechanical defects. To obviate these difficulties, a new electric power unit has been constructed and is presented for consideration.

FEATURES

Shell: The most outstanding feature of the unit is the tight duraluminum shell, which protects the motor and drive-shaft mechanism from moisture, thus permitting sterilization in an autoclave.

Motor: A universal motor, with a voltage of 220, is used, and it is wound with special heat-resisting wire, tolerating a temperature of 500 degrees Fahrenheit. The solder used for the motor has a high melting point.

Speed: The motor develops one-eighth horsepower, but the maximum speed of the drive-shaft is reduced to 2000 revolutions per minute by a gearing system. In the writer's opinion, this is a distinct advantage in drilling or sawing, as there is not the tendency toward burning the bone. The speed of the average motor varies between 6000 and 8000 revolutions per minute.

Drive-Shaft: This shaft is composed of stainless steel, and is seven inches in length and canalized throughout to one-fourth of an inch. It is held in place by sealed bearings, and operates at a right angle to the motor by means of spiral bevel gears. The canalization of the drive-shaft permits the use of the unit for the insertion of Kirschner wires.

Chuck: Fastened to the operating end of the drive-shaft is a canalized one-fourth-inch universal chuck, which is used to hold drills of various sizes or saw arbors.

Greasing and Oiling: The drive-shaft mechanism is mounted in sealed bearings, making greasing and oiling unnecessary except for the periodic removal of the screw cap on the head of the motor and the placing of some vaselin on the spiral bevel gears.

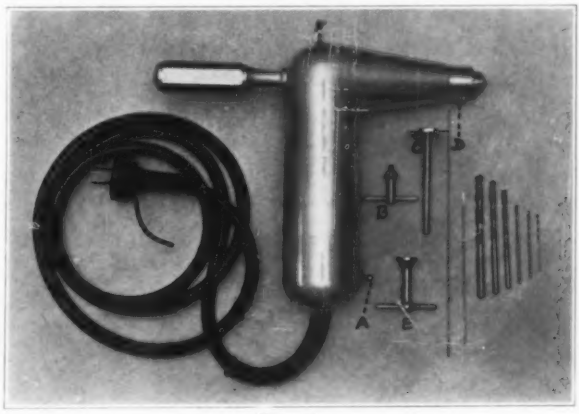


FIG. 1

A = switch; B = chuck key; C = single saw; D = chuck; E = key for removal of screw cap F.

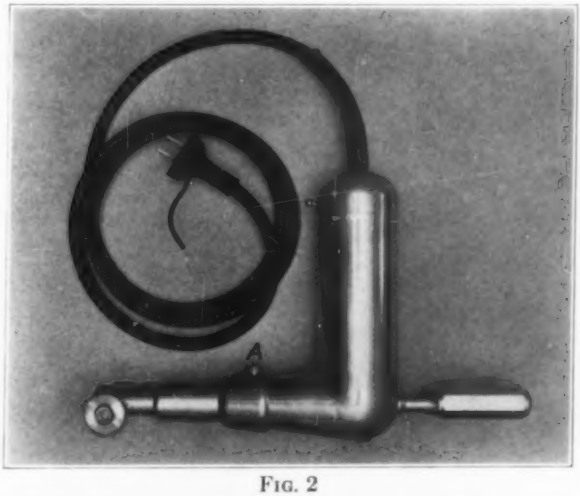


FIG. 2

Longitudinal saw. A = set screw.

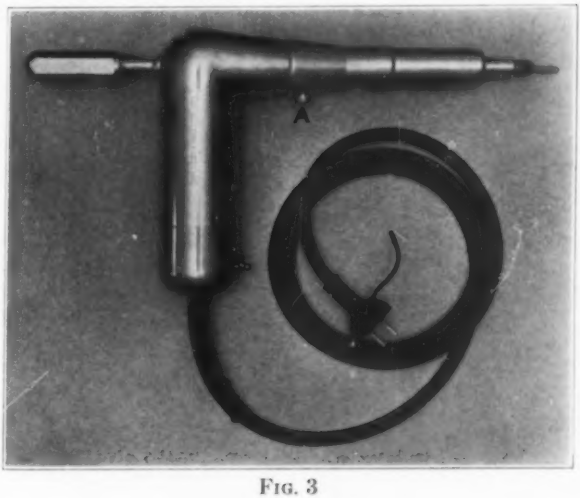


FIG. 3

Jig saw. A = set screw.

Cable and Switch: A long, rubber, electroconducting cord is provided to transmit current from the source of supply. The switch is conveniently located (Fig. 1) and mounted on the inside of the shell, to eliminate the possibility of sparks. This permits operation of the motor in the presence of explosive anaesthetics.

Weight and Size: The weight of the power unit without the attachments is four and one-half pounds. It measures eleven inches from the tip of the chuck to the tip of the handle and eight and one-half inches from the tip of the screw on the head of the motor to the entrance of the electroconducting cable; the circumference of the body of the unit measures eight inches.

Attachments: Longitudinal and jig saws are mounted on the nose of the power unit (Figs. 2 and 3). These attachments can be applied or removed with ease by operation of a set screw (*A*).

COMMENT

The unit described has been sterilized in an autoclave over fifty times, and cultures after each sterilization have failed to show any growth of bacteria. The heat from the sterilization has not affected the working efficiency of the motor or the drive-shaft mechanism.

THE WHITMAN RECONSTRUCTION OPERATION

To the Editor:

I note, in successive numbers of *The Journal*, papers on arthritis deformans of the hip, which seems to indicate a renewal of interest in operative treatment. Hence this communication.

One of these operations, "the bone block", is presented as a novelty, and as such it invites comment. A section of bone of sufficient length is cut from the side of the pelvis and implanted above the acetabulum, so that its lower end may impinge on the outer border of the neck, thus checking abduction, but permitting motion in other directions. The operation is based on the observation that abduction of the limb causes pain, which is relieved by flexion and adduction. The bone block is an adaptation to this indication, and "unless it induces flexion and adduction it must be classed as a failure". In spite of this obvious disadvantage, the author concludes that the results are more satisfactory than those attained by arthrodesis, which, in his opinion, offers "the only sure promise of relief", because motion is retained.

I shall, therefore, call attention to an alternative, which offers a prospect of permanent relief and which does not entail either deformity or fixation of the joint. The pain and disability of arthritis deformans are caused by friction of the roughened surfaces of the joint, aggravated by weight-bearing in locomotion. The strain of impact is lessened by the involuntary attitude of flexion and adduction of the limb. This concentrates the attrition on the outer border of the acetabulum and induces a subluxation, which, by checking both motion and friction, establishes a natural cure by an exaggeration of the attitude, which it is the purpose of bone block to induce.

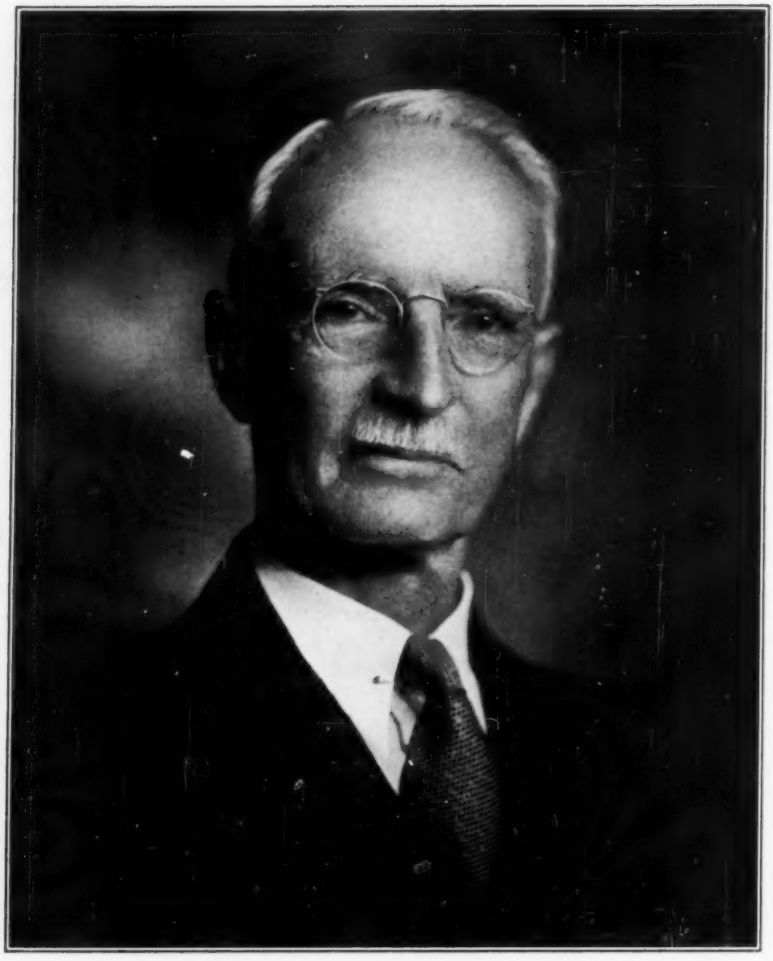
The alternative suggested is the reconstruction operation, described in *Annals of Surgery* in 1924 and 1925, which is more radical than the bone block and more conservative than arthrodesis. The joint is opened, and the deformed head is extruded and reshaped. All of the cartilage and underlying bone are removed, leaving a smooth, rounded extremity, which is replaced in the acetabulum by abducting the limb. The trochanter is then transplanted to a denuded surface on the other border of the femur, as low as the tension on its attached muscles will permit, in order to restore effective leverage. Hence the term "reconstruction". A plaster spica is applied in extension and abduction and is retained until the union of the trochanter is assured. The articulating extremity of the neck is soon covered with fibrous tissue, and its small size within the capacious acetabulum, from which all excrescences have been removed, offers little opportunity for disintegrating friction.

When the support is removed, the after-treatment, on which the result depends, is begun and carried on indefinitely. This consists of a regular routine of manual stretching of the limb in the directions of extension and abduction, to counteract the persistent tendency toward flexion and adduction. If the range of extension is thus assured, that of flexion will be sufficient to permit the patient to sit with comfort. If the patient is instructed in the equal step, the habitual limp may be in great degree overcome.

Arthritis deformans offers a very favorable opportunity for this form of arthroplasty, since the cartilage of the deeper surface of the acetabulum is often in fairly normal condition, and the pressure of weight-bearing should be directed to this area by the habitual attitude of slight abduction in locomotion.

From this operation, since the chief cause of progressive disability has been removed, one may expect permanent relief from disabling symptoms, bodily symmetry, and a fairly normal gait. In other words, it stands on a higher plane both in purpose and in execution than the bone block, intertrochanteric osteotomy, or arthrodesis, the procedures with which it may be compared. The reconstruction operation is equally serviceable for other conditions, but the contrasting principles of the two procedures are best illustrated in the subject under discussion.

London, August 5, 1939 *Royal Whitman, M.D.*



HERBERT PETER HOWELL GALLOWAY

1866–1939

Dr. Herbert Peter Howell Galloway died on July 13, 1939, at the age of seventy-three, in the Winnipeg General Hospital after a brief illness. He died in harness, for, in spite of his advanced years, his work had been carried on with full vigor up to the morning of the onset of the fatal illness.

Dr. Galloway was born at Hawkesville, Ontario, and he entered the profession of medicine as an apprentice when a youth, receiving the degree of Doctor of Medicine from Victoria University, Toronto, before he was twenty-one. After nine years in general practice in that City, he became associated with the late Dr. B. E. McKenzie and devoted the remaining forty-three years of his life to orthopaedic surgery. In 1905, he moved to Winnipeg, and became the pioneer orthopaedic surgeon of Western Canada. His ability was early recognized. For many years he was Chief of the Orthopaedic Staff in the Winnipeg General Hospital and in the Children's Hospital, and Associate Professor of Surgery on the Faculty of Medicine of the University of Manitoba, in charge of the teaching of Orthopaedic Surgery. He always took a prominent part in the activities of organized medicine, and served as President both of the Winnipeg Medical Society and of

the Manitoba Medical Association. He was early elected to membership in the American Orthopaedic Association, and in 1919 served as its President. During the latter years of the World War, he took charge of the Orthopaedic Service in the Manitoba Military Hospital, with the rank of Lieutenant Colonel, C.A.M.C.

His ability to think clearly, coupled with an exceptional endowment of common sense, enabled him to make correct decisions and to select at once the form of treatment best suited to the case in hand. He seemed to have an uncanny faculty of determining which patient would be benefited by operation and which would not. While he was quite willing to speculate with others as to the cause of a deformity, and how it might have been prevented, his attitude in the white heat of practice was: "Here is a crooked limb; let us straighten it." Intuition told him and experience proved that when such a limb was straight it would be more useful.

He had no patience with cant or fraud. His work was characterized by a forthright honesty and simplicity of method that never failed to impress those who worked with him. The same qualities made him a wonderful teacher. Indeed, it is perhaps as a teacher of medical students, internes, assistants, and junior associates that he will be best and most widely remembered throughout Western Canada.

Galloway of Winnipeg (or should one say of Canada) was known throughout the surgical world through his many contributions to the study of various orthopaedic conditions. The most notable of these were on resection of the knee and open reduction of congenital dislocation of the hip. He published his first paper on the latter subject in 1920, in which he reported the results in thirty-seven cases. He was convinced that the constriction of the capsule, present in all cases in which he had operated, made closed reduction impossible in the majority of patients, and that the trauma inflicted by forcible attempts at reduction was greater and more dangerous than that incident to open reduction. During the 1920's, he preached this gospel with missionary zeal, and nothing gave him greater pleasure than to read of one of his colleagues who had adopted the open operation. It is safe to say that during those years no article of importance on this subject appeared without some reference to Galloway's work.

While never a boon companion, he formed firm and lasting friendships, which included many of the members of the American Orthopaedic Association. In 1912, he spent some time in England with the late Sir Robert Jones, and their friendship continued to the time of the latter's death a few years ago.

He was devoted to his family and took a keen interest in all their plans and activities. He was deeply religious, and, although most of his religion was expressed in his daily work as a surgeon, he was an ardent supporter of his church. One of his favorite quotations from the Scriptures he used ten years ago in closing a Listerian Oration: "Who shall ascend into the hill of the Lord? Or who shall stand in His holy place? He that hath clean hands and a pure heart." Such a man was Dr Galloway.

ARTHUR THORNTON LEGG

1874–1939

On July 8, 1939, Dr. Arthur T. Legg died suddenly at the Harvard Club, Boston, Massachusetts, in his sixty-sixth year.

Dr. Legg attended Harvard College and received his degree from Harvard Medical School in 1900. He began the practice of orthopaedic surgery in 1902, and was elected to membership in the American Orthopaedic Association in 1908. Early in his career he became concerned with the problems of the crippled child, and the absorbing interest of his life was his work at the Children's Hospital in Boston, which he served for a period of thirty-nine years, first as a house officer and then as a surgeon and a teacher. He was known the world over not only for his discovery of the hip condition known as Legg's disease, but also for his excellent and careful work in connection with infantile paralysis. He was the representative of the Harvard Infantile Paralysis Commission at the Children's Hospital, and his judgment in regard to operative procedure in infantile paralysis was respected by everyone.

Dr. Legg was Assistant Professor of Orthopaedic Surgery at the Harvard Medical School and a consultant at many hospitals throughout New England. He had charge of the infantile paralysis cases at the Lakeville State Sanatorium, Middleboro, Massachusetts, and was consultant to the State Department of Public Health. At one time Dr. Legg was Chairman of the Section on Orthopaedic Surgery of the American Medical Association and, in 1933, he was Vice-President of the American Orthopaedic Association. He was a Fellow of the American Academy of Orthopaedic Surgeons and of the American College of Surgeons and a member of the New England Paediatric Society.

A good teacher and an excellent surgeon, Dr. Legg was withal a kind, modest fellow, who never put himself forward, but when his opinion was asked he was always ready to give it, and his advice was generally very valuable. To be sure, he was conservative, but when an operative procedure or a method of treatment had been proved to be satisfactory, he was anxious to adopt it. Ever willing to help in any way possible, Dr. Legg will be remembered by his associates and the many whom he served as a good and loyal friend.

News Notes

The Eighth Annual Convention of **The American Academy of Orthopaedic Surgeons** will be held in Boston, Massachusetts, January 21 through 25, 1940. The Hotel Statler will be the headquarters for the Convention.

Dr. Alan DeForest Smith, of New York, is Chairman of the Program Committee. Dr. M. N. Smith-Petersen will be in charge of the Clinical Day.

The program of the Meeting is not yet completed, but will be sent to members of the Academy and will be published in full in the January issue of *The Journal*.

The Journal is glad to announce that an honorary degree of Master of Arts was conferred upon Dr. Roland Hammond, of Providence, Rhode Island, by Tufts College on June 19, 1939.

Dr. J. Sims Norman announces that he is no longer associated with the Corwin Hospital Staff and has opened offices at 629 Thatcher Building, Pueblo, Colorado.

The Annual Meeting of the **Orthopaedic Guild** will be held in Cleveland, Ohio, on December 1 and 2, 1939, under the chairmanship of Dr. Maxwell Harbin.

The Sixty-Eighth Annual Meeting of the **American Public Health Association** will be held in Pittsburgh, Pennsylvania, October 15 to 20, 1939, with headquarters at the William Penn Hotel.

The next examination of the **American Board of Orthopaedic Surgery** will be held in conjunction with the meeting of The American Academy of Orthopaedic Surgeons in Boston, Massachusetts, in January 1940. Applications for this examination must be filed with the Secretary on or before November 1, 1939.

The 1939 Annual Meeting of the **Clinical Orthopaedic Society** will be held in Oklahoma City, October 13, 1939, and in Little Rock, October 14. A very instructive program has been arranged, and a large attendance is anticipated. The officers of the Society are as follows: President, Dr. R. W. Billington; Vice-President, Dr. Dale Wilson; Secretary-Treasurer, Dr. H. Earle Conwell.

The Bone and Joint Club of Indiana was organized on April 26, 1939, at the Indianapolis Athletic Club, and the following officers were elected: President, Dr. E. B. Mumford; Vice-President, Dr. Gordon W. Batman; Secretary-Treasurer, Dr. Charles F. Thompson. This Club, which is composed of thirty members from different sections of the State of Indiana, will meet two or three times a year for round-table discussions of the bone and joint problems which are encountered by the members.

The Thirteenth Annual Congress of the **Deutsche Gesellschaft für Unfallheilkunde, Versicherungs- und Versorgungsmedizin** took place in Kiel, on July 7 and 8, 1939, under the chairmanship of Prof. Dr. A. W. Fischer. Three hundred members attended this Congress.

The first morning session was devoted to the presentation of a paper by Prof. Bohnenkamp, internist from Freiburg, who discussed the adaptation of social thinking and social legislation in the Third Reich to the principles of progressive national concepts. The recognition of the residual working capacity of an injured patient is more important than the estimation of the disability. This capacity should be developed and increased by occupational therapy and reeducation. To assure the patient's readjustment to the community activities, it is important to recognize the early stages of injury and to provide workers well-trained in this type of therapy.

Dr. Kötzing discussed occupational skin diseases and their prevention. He considered two main groups,—the tissue eczemas and oil dermatitis. Skin hygiene by appropriate bland methods is the best treatment; two new washing materials, "*Präkutan*" and "*Satina*", are reported as having given good results.

Prof. Bürkle de la Camp (Bochum) considered the question of tissue injury by compressed-air apparatus, and laid particular stress upon the exclusion of underlying constitutional diseases. Joint changes, particularly in the elbow, are the general expression of an arthrosis and are not particularly characteristic of injuries due to work with compressed-air apparatus. Vascular or nerve disturbances, as a result of such work, were not observed.

Dr. von Karitsky (Freiburg) discussed the preservation of the circulation in operations, with particular regard to the maintenance of body warmth. Prof. Hohmann (Frankfurt a. M.) considered the general topic of osteotomy from a topographic point of view. Dr. Watermann (Frauenburg) discussed graduated exercises in overcoming the chronic stiffness following fracture. Dr. Thomsen (Frankfurt a. M.) demonstrated by films the progress of patients with bilateral ankylosis of the hip. Dr. Müller Osten (Kiel) spoke on separation of the symphysis, and Dr. Gross (Bochum) presented a paper on open knee-joint injury. Dr. Heim (Kiel) discussed pseudarthrosis of the navicular, and Dr. Robbe (Kiel) considered calcification of the elbow-joint capsule, mainly from a therapeutic point of view.

The afternoon session was introduced by a presentation by Prof. Gebhardt (Hohenlychen) on the after-treatment of joint injuries. Exercises and gymnastics are only of value after internal preparation of the injured person. The need for functional stimulation develops spontaneously after a period of rest. Although exercises should not be undertaken until the complete subsidence of the inflammatory period, atrophy should not be permitted to develop. In this regard, graded Zander exercises and the personal efforts of the physician are extremely valuable.

Dr. Baumecker stressed the value of rest *and* motion in preference to treatment by rest *or* motion. Prof. Pitzen (Giessen) discussed the anatomical basis of joint dystrophies. Dr. Bayer (Hohenlychen) stated that, where injury to the common peroneal nerve was associated with injury to the fibular collateral ligament, the restoration of this ligament must precede recovery of the nerve. Where the nerve is not completely torn through, rest is the first method of treatment. Dr. Köstler (Hohenlychen) discussed the use of padded and unpadded plaster bandages. Dr. Heiss (Berlin) spoke on the importance of sports, and particularly water sports, in the rehabilitation of the injured patient. Numerous photographs, taken through an underwater window, were shown.

On the second day, Dr. Köstlin (Stuttgart) discussed the dangers of enemata, and Dr. Jungmickel reported on the influence of alcohol upon accidents. Dr. Blotevogel (Breslau) demonstrated the detoxicating influence of vitamin B, after burns. Dr. Lichtenauer (Stettin) stressed the responsibility of the physician in neglecting to take roentgenograms. Dr. Gollasch (Hamburg) presented a paper on the significance of the bipartite navicular in the recognition, treatment, and legal aspects of injuries to the navicular. Dr. Bufe (Rostock) described his experiences in dealing with injuries caused by light metals.

The next meeting of the Society will take place in Freiburg, under the chairmanship of Prof. Bohnenkamp.

The Fourth **World Conference of Workers for Cripples** was held in London, July 16 to 22, 1939. At this Conference were gathered together representatives from every continent, including official delegates from the chief governments in each. These delegates were not mere figures at the Conference, for most of them contributed valuable first-hand information about the organization of the care of cripples in their respective countries.

The President and opener of the congress was Lord Nuffield, who has done so much to expand and to initiate orthopaedic institutions all over the British Empire. Lord Nuffield more than once expressed his conviction that money spent on the treatment and training of cripples was one of the soundest investments.

During the week of the congress, the participants were given an opportunity to visit many institutions which deal with cripples, among which were the Royal National Orthopaedic Hospital, Country Branch, Stanmore, and the Wingfield-Morris Orthopaedic Hospital, Oxford. A whole day was spent at Oxford, and the delegates had an unforgettable experience in their tour of the colleges, with lunch at Christ Church and tea at Worcester.

An interesting session was devoted to "The Education, Vocational Training, and Subsequent Employment of the Crippled Child". Mr. Cecil Maudslay, of the English Board of Education explained the system of government grants to day schools, hospital schools, etc. He also pointed out that the organized treatment of cripples since the Great War has so reduced the need for special day schools that most of these have now been turned over to children with heart involvements, who are unfitted for the stress of ordinary school life.

After explaining the Danish Government's plan, Prof. Paul Guildal, of Copenhagen, also stressed the desirability of returning cripples to normal home and school conditions. This is usually possible when orthopaedic treatment is early and thorough.

Prof. Richard Scherb, of Zurich, gave an account of arrangements in Switzerland, where government support reinforces philanthropic agencies in certain fields.

Mrs. J. G. Norris, of Melbourne, reviewed the development of work among crippled children in the various states of Australia, and Dr. Douglas Galbraith, in describing the Orthopaedic Section of the Melbourne Children's Hospital, announced that 60 per cent. of the beds were occupied by children with surgical tuberculosis.

In his discussion of "Preventive Orthopaedics in Childhood", Mr. R. C. Elmslie, of London, gave an interesting review of the evolution of orthopaedic practice in his own experience, remarking that in his student days the work of the orthopaedic department was concerned with correcting severe rachitic deformities and applying palliative treatment in cases of kyphosis resulting from tuberculosis (which were considered suitable for out-patient treatment) and in cases of severe scoliosis. He considered that improved national hygiene had abolished rickets and reduced the cases of tuberculosis to small proportions, while better clothing and physical training for girls, together with school inspection, had eliminated many of the cases of scoliosis. He quoted statistics showing that, where formerly nearly all the new cases of scoliosis were in patients under the age of twenty, now the majority of cases are in elderly patients.

Dr. George W. Armstrong, of Ottawa, reported that nowadays 90 per cent. of Canadian milk is pasteurized and most of the herds are tuberculin-tested, to which he attributes the reduction in the number of cases of tuberculosis. He also explained how, in the 1937 epidemic of poliomyelitis, the treatment was organized, so that from the onset patients came under the care of an orthopaedic surgeon and had the advantage of early splinting and three weeks' in-patient treatment to initiate care on sound lines, followed by six months on a Bradford frame with appropriate standardized attachments for the limbs. Physiotherapy was provided during convalescence. Through Lord Nuffield's generous gift of "iron lungs", it was possible to save many cases of respiratory paralysis and to reduce the average mortality to about 4 per cent.

One evening was devoted to the showing of an interesting series of films, dealing with the life in institutions for cripples. These included a fine color film of the Haifa

Hospital, exhibited by Dr. Rosenberg, the delegate from Palestine; another demonstrated the improved balance in spastic cases after operation, presented by Dr. J. van Assen, of Rotterdam; and in a most impressive film were displayed cineplastic amputation stumps, illustrating the function which was possible with a suitable appliance, shown by Dr. Henry H. Kessler, of Newark, New Jersey. Colonel Strover, of the Woodlarks Camp, Farnham, and Dr. Zinner, of Budapest, appealed for the provision of recreation, as well as education, for all cripples, and accompanied their pleas with films of scouting activities, showing an admirable morale in lads with severe physical handicaps. The very existence of such cases convinced one of the need for such an international conference.

One of the most interesting discussions was that on "The Industrial Cripple", under the chairmanship of Mr. Cheneaux de Leyritz, an expert from the French Ministry of Labour. Mr. Maurice Stack, of the International Labour Office, Geneva, reminded the audience that at present, when the old causes of crippling are being eliminated, industry is the greatest producer of cripples, keeping a "standing army" of about a million cripples, so that about 7 per cent. of the male population of working age are permanently incapacitated. He commended the system used by some insurance companies, under which employers who take efficient precautionary measures against accidents benefit by reduction in the premiums. He also reminded the audience that compensation rates must steer between two evils,—either making sickness as profitable as work or reducing the wage below a level at which the injured person can obtain sufficient nourishment for good healing. He considered the German scheme of paying two-thirds the usual wage during total incapacity as sound, but he added that provision must be made above this for the purchase and regular repair of appliances in cases where they are required permanently.

All the speakers stressed the need of maintaining the injured man's confidence in himself and in his doctor and for retraining him after surgical convalescence is complete. It was also emphasized that rehabilitation must be regarded as a social duty and not merely as an economic measure, and that it consists in providing assistance from the moment of injury until complete cure has taken place, and in helping even the permanently incapacitated back to some kind of work and supplementing their earnings. It was agreed that, excluding minor injuries, all industrial-accident cases should have in-patient treatment under a specialist, and that cure should have no arbitrary time limits, as it does in some countries.

Dr. Lauterbach, a representative of the German Government, gave a long and detailed account of the arrangements under the Nazi regime, which appear to be absolutely complete and on admirable lines. Family allowances for dependents are given during in-patient treatment, but all benefits are refused if there is proof that the accident was due to negligence or deliberate intent on the part of the injured man.

Dr. John A. Kratz, of Washington, D. C., gave interesting statistics showing that in the United States home accidents preponderate, with road accidents next, while the industrial accidents account for only 17 per cent. of the total. In the unfortunate absence of Dr. Kratz, his paper was admirably summarized by Mr. Paul King, who also presided jointly with Lord Nuffield at the Conference Dinner.

Those who made the afternoon excursion to the new Albert Dock Hospital, an offshoot of the famous "Dreadnought" floating hospital, saw all these theories put into practice with admirable results in the fracture department, which owes its organization to the Senior Surgeon, Mr. Griffiths, whose enthusiasm keeps up the morale of the patients in splendid fashion. Organized games and gymnastic work were carried out with obvious pleasure by about fifty out-patients, in all stages of convalescence.

The final session of the Conference was devoted to an expedition to the Heritage Craft Schools, Chailey, where the genius and enthusiasm of its founder, Mrs. G. T. Kimmins, keep alive a similar activity and happy atmosphere in crippled children of both sexes and of all ages, who are fortunate enough to spend their education period in the "Public School of Crippledom".

Current Literature

LES "PIÈGES" DE LA CHIRURGIE EN DIAGNOSTIC ET THÉRAPEUTIQUE. ERREURS ET FAUTES OU FAITS PRÉSUMÉS TELS. CONDITIONS ET LIMITES DE LA RESPONSABILITÉ (Pitfalls of Surgery in Diagnosis and Treatment. Real or Assumed Errors and Faults. Conditions and Limits of Responsibility.) Prof. E. Forgue and Prof. Aimes. Paris, Masson & C^ie^, 1939. 120 francs.

This very unusual book on an unusual subject could have been produced only after long experience, characterized by accurate observation, clear and honest thinking, and self-analysis. It is true that experience is the truest and safest guide in forming judgment as to action and in pointing out errors and dangers to be avoided, but it is usually the attribute of maturity. Advance must come through experience, but it should not be necessary that each individual repeat the mistakes of others to attain it; rather should he begin at the level which others have reached. It is seldom, however, that we have the results of mature experience so recorded that they may guide and be of practical use to those who have not had this advantage. This book is of especial significance, because of the high ethical plane of conduct and the straight and direct thinking on which the authors have insisted.

In the first part of the book are discussed in a comprehensive manner the mistakes which are easily made in the course of examination and observation, both mental and physical. The first contact with the patient, the examination, and the interpretation of the signs and their significance with relation to the mental attitude of the patient are carefully considered. Errors that may be avoided by the recognition of the pitfalls which may intrude themselves in the routine, either because of lack of familiarity or because of insufficient care on the part of the surgeon, are pointed out. Emphasis is placed on the necessity of assiduous attention to these factors to eliminate errors due to hasty or incomplete examination, and there is included a long list of fundamental precepts, which, because of their practical application to the conduct of dealing with patients and disease, must evidently have been formulated during the course of personal experience.

In the second part of the book are discussed the general rules and methods to be followed in dealing with the patient, with a strong plea for the strict adherence to the conduct which will ensure the best treatment of the patient. The legal responsibilities which may be incurred in the course of every surgeon's experience and the care which should be taken by the surgeon to avoid these complications, as well as his conduct toward the legal code which protects the patient, are given consideration. A helpful discussion of the limits of the surgeon's responsibility as regards these legal relations is included, and the importance of caution in discussing the factors in any case which may be the source of subsequent legal proceedings is emphasized. The fairness of this advice will be acknowledged by everyone.

In the third portion of the book, special affections and different anatomical regions are considered, with a discussion of the lessons which may be learned by the application of much which has been brought out in the first two parts. The special precautions which are applicable to each affection and in the different surgical procedures are to be found in the discussions of each.

The book demonstrates the inestimable value of experience combined with open-mindedness and an earnest desire to give that quality of service which is due to each individual who in trust puts himself under the care of a surgeon. There is much which cannot be gained either in the schools or in the early hospital experience of the young surgeon, for, during this period, he is only laying the foundation of the scientific knowledge on which he must later build that still more valuable but less scientific structure, experience. In this book, the grafting of the results of mature experience on those essential and stimulating qualities of youthful energy and enthusiasm has made a composite

which approaches the ideal. This honest recognition and analysis of errors, so that they may be avoided by those who follow, is a significant contribution to the medical profession.

FUNCTIONAL DISORDERS OF THE FOOT. THEIR DIAGNOSIS AND TREATMENT. Frank D. Dickson, M.D., F.A.C.S., and Rex L. Diveley, M.D., F.A.C.S. Philadelphia, J. P. Lippincott Co., 1939. $5.00.

The authors of this very valuable text point out that foot disorders have become so prevalent in America that they constitute an economic and social as well as a medical problem. Unfortunately, the medical profession itself has shown some indifference to the importance of studying this problem, and a book of this sort is needed to rekindle the practitioner's interest and to guide him toward "intelligent evaluation of the faults" which exist. The authors add, modestly, that their material is "perhaps elementary", but this will be found to apply only to the clarity with which they present a subject which is too often confused by abstruse theory.

There is, at the start, ample description of the foot's evolution, anatomy, and physiology, with comparison of its functions as adapted to arboreal and to terrestrial life. The descriptions of the bone structures, the musculature, and the physiological actions are confined to their more clinical applications and form a sound introduction to the topics that follow. Particular emphasis is given to analyzing the factors affecting foot imbalance. The specific etiological forces responsible for each of the functional disorders are discussed with a thoroughness that makes it easy to accept the corrective principles drawn from the study. Treatment is planned both to remedy local weakness and to correct any constitutional deficiencies which may be present. The objective is succinctly described as aiming "to convert an unbalanced foot into a balanced one and maintain it in its balanced position". Space does not permit a summary of the various measures which are suggested for accomplishing this end. In general, it may be said that the authors do not follow any arbitrary rule or fad. Rather, they offer a well-balanced program, which includes shoe corrections, stretchings, manipulations, exercises, and operative stabilizations, as well as attention to overweight from endocrine disturbance and to deficiencies of calcium and phosphorus. The selection of the appropriate method of treatment is intelligently evaluated, with emphasis upon the age of the patient. The importance of conservative measures in childhood is stressed. In adolescents, the value of operative measures for certain resistant cases is recognized. Conservative corrections are favored in adults, except for cases of very severe symptoms in young adults, in which early relief is essential.

The final chapters of the book are devoted to a complete review of the various foot disorders and their treatment. This includes not only very able discussions of hallux valgus, hallux rigidus, hammer-toe, and metatarsal-bone pathology, but also such topics as ingrowing toe nails, skin affections, and affections of the heel. There are two practical and very helpful chapters on foot strapping and foot exercises, and a brief, but most useful, chapter on "foot apparel".

All in all, this material is presented with such clarity that it could be utilized for nurses' training courses or for the more advanced lay student; and yet it is so comprehensive and thorough in covering the subject that orthopaedic specialists will find it a valuable reference book.

TREATMENT BY MANIPULATION. A. G. Timbrell Fisher, M.C., M.B., Ch.B., F.R.C.S. (Eng.). Ed. 3. New York, Paul B. Hoeber, Inc., 1939. $3.75.

A third edition of this book on manipulation bespeaks an interest in this subject in Great Britain that might well be imitated in the United States. It is to be hoped that this edition will reach enough readers in America to stimulate an interest that is all too slowly being aroused. Physical therapy of any kind received a cold shoulder in this

country prior to the War, largely because many of those first to practise it were charlatans. Fear of being classed with the "quacks", actuated by mercenary motives, restrained physicians from even investigating the claims of those who were honestly trying out such methods. The medical schools, moreover, have given very little prominence in their curricula to this sort of therapy. Success attending the ministrations of the "natural bone-setters" and the publicity accorded now and again to an individual who has gained a reputation for having some sort of a "magic touch", which enables him to effect cures not attainable by others, are forcing the medical profession to devote more attention to such matters. The cures obtained by members of the different cults, having as a basis of their philosophy of treatment the principles of mechanical adjustment through the medium of more or less forceful manipulation, have at last convinced the profession that they have been leaving a field of practice, very essential to their success, to others far less qualified to cultivate it than are they themselves. In Great Britain this feeling seems to have taken a much firmer hold than it has here.

This book was written very largely in an attempt to bring forcibly home to doctors the views of the author and his reasons for them. The general principles for the treatment of patients laid down in the text are, for the most part, in common use and should meet with rather universal agreement. It is quite likely that in this country we have been too conservative in the application of manipulative methods to the management of chronic arthritis. In his discussion of meniscus dislocations, the author seems rather more optimistic about forcefully replacing a dislocated meniscus and having it remain reduced than most American surgeons would be willing to admit. He apparently feels that cures are secured often enough by this method to justify a primary attempt at a cure by manipulation before resorting to excision.

In his consideration of "chronic foot strain", under which heading he includes "flat-foot", "metatarsalgia", "hallux valgus", and "hallux rigidus", he has gone a little ahead of his American colleagues in his departure from mechanical treatment and his advocacy of manipulative measures, but his results would seem to justify him in so doing. Had there not been such an extremist as Locke to steer us away from manipulation, we should be as far along now as is Fisher. The appropriateness of manipulative methods in the management of sprains of the spine and of the early arthritic lesions in this locality, as well as in the sacro-iliac and lumbosacral articulations, is emphasized in his case reports.

The anatomy of the region under discussion is outlined, and the indications for and against manipulation are discussed. The description of the manipulative procedure is clearly defined and in many cases well illustrated. The book should be read by everyone who wishes to be equipped to render the best service to patients suffering from the results of joint injuries and inflammations.

PHYSIOLOGIE ET PATHOLOGIE DU TISSUE OSSEUX (Physiology and Pathology of Bone Tissue). René Leriche. Paris, Masson & C^ie^, 1939. 100 francs.

This book is based on the lectures which the author gave at the *Collège de France* during the year 1938. The preface contains an excellent and clear summary of the important physiology, theories, and facts which should always be borne in mind during the study and treatment of any pathological process. This résumé, together with a statement of the author's own point of view and the influences which led him to undertake the production of this work, is very helpful in studying the material which follows.

The scope of this work is broad and comprises the study of the normal growth, structure, and composition of bone, with the conditions which control or influence its development and the changes which accompany interference with the normal processes. This very large field is considered under the following divisions:

1. Physiopathology of bone;
2. The composition of bone;
3. The vitality of cartilage;

4. The vitality of osseous tissue;
5. The rarefaction of bone;
6. The etiological conditions influencing this rarefaction;
7. Osseous rarefaction of traumatic origin;
8. Hyperaemic rarefaction in certain traumatic conditions;
9. The localized rarefaction in interosseous diseases;
10. Rarefaction in circulatory and nervous conditions;
11. The osseous rarefaction produced by vitamins D and C and the rarefaction of endocrine origin;
12. The results of osseous rarefaction;
13. Ossification in the vicinity of rarefaction;
14. Elimination of calcium following osseous rarefaction;
15. Sequestra and the mechanism of their formation.

In the introduction to the study of the physiopathology of bone, the author gives an interesting and helpful chapter in which are considered the factors that influence the growth and the changes in bone and have a special significance in regard to the tissues of the structures which are dealt with in detail in the latter part of the book. A large part of the work deals with the processes which result in rarefaction, and these are grouped with regard to the etiological factors which are active in producing this special pathology. Each portion of the subject has a full discussion of the etiological factors, the pathological processes, and the clinical evidences. The action of the endocrine glands and of the vitamins—the two factors which are now receiving more attention than any others—are given careful consideration. All of this makes the results of this study particularly helpful in understanding the clinical picture in relation to the pathological changes. The book is well illustrated by photographs of gross specimens and by photomicrographs.

By generous quoting from other investigators in this special line of bone study, the author allows the reader to form a clear idea of what has been accomplished in the preceding period. The increased facilities for studying processes in bone, particularly the influence of the endocrine glands, have recently permitted much more accurate and rapid diagnosis and, consequently, more successful treatment.

This book contains much that requires careful study, but the different phases are so well divided that the reader can easily turn to any special portion in which he may be interested.

A Textbook of Surgery: By American Authors. Edited by Frederick Christopher, B.S., M.D., F.A.C.S. Ed. 2. Philadelphia and London, W. B. Saunders Co., 1939. $10.00.

The promptness with which this second edition has been published is indicative of the pleasing response to the first edition and the purpose of the authors to keep this textbook up-to-date. Nearly 200 physicians have contributed to this work, some of them making their first appearance in this edition, and each section is signed by its author.

New sections have been added on carcinoma of the lip and tongue, congenital obstruction of the bile ducts, tetanus, lymphogranuloma inguinale, the autonomic nervous system, and the anatomy of the anal canal and rectum, with a discussion of the diseases of this region. The use of sulfanilamide has been discussed by twelve authors from the point of view of their various specialties. Such new subjects as the excision of the patella for fracture, the diagnosis and treatment of ruptured intervertebral discs, and a new operation for removal of carcinoma of the head of the pancreas are included.

The initial chapter deals with "inflammation and the repair of tissue", the background of all surgical procedures. "The relationship of bacteriology to surgery" follows. Such material, absent in a textbook of surgery of a decade ago, indicates the interrelationship of the branches of medicine and science and its recognition by the authors. Fractures assume a very important part in this treatise and the pages assigned to them make up more than 10 per cent. of the total. Tumors are given full considera-

tion. The drawings of various incisions for operation on cancer of the breast and the drawings of the lymphatic channels involved by the cancer are particularly well done.

While this is called a "textbook" and may be used to advantage by students of surgery, it might as well be described as an "encyclopaedia of surgery". The gist of all important operative procedures is given, and every subject is very completely covered. Dr. Christopher has done a beautiful piece of work in editing this book.

TRATAMIENTO RACIONAL DE LAS FRACTURAS Y LUXACIONES (Rational Treatment of Fractures and Dislocations). Lisandro Leyva Pereira. Bogotá, Editorial Centro, 1937.

This book of 359 pages is divided into several parts. There is one large portion consisting of several chapters dealing with general concepts in the treatment of fractures and with special problems in this connection. The rest of the book is divided into two parts,—one dealing with specific fractures in different locations and the other dealing with dislocations.

The first part starts off with an elementary discussion of the objects of treatment and the general methods of treatment available for fractures. Detailed instructions for the making of casts and for the application of extension apparatus are given. The chapter on the treatment of open infected fractures is interesting, because, instead of employing the method of Carrel and Dakin or using the Bipp ointment so popular in England, Prof. Pereira deplores both of these forms of treatment. He believes that a paste made of sucrose and the oxides of calcium, potassium, sodium, and aluminum, with certain other salts and elements in small proportions, is very much better. He says the superiority of this paste over the Carrel-Dakin solution is due to its quicker action, greater ease of application, greater economy, and the fact that it is a hemostatic agent. There are also chapters on anaesthesia and physiotherapy.

The sections dealing with specific fractures are well illustrated, and the mechanical principles involved in the treatment are clearly brought out. One point in the discussion of the treatment of fractures is particularly outstanding, and that is the author's preference for special types of apparatus for each fracture rather than the extensive use of casts; this is in rather marked contrast with the ideas which prevail in the United States. It appears that his apparatus in general resembles that used by the Europeans, especially by the French. There are very detailed discussions of the methods of treating specific fractures with the particular types of apparatus employed. In general, the discussions of principles of treatment are good. In his opinion, all types of fractures of the neck, trochanter, and shaft of the femur should be treated with suspension traction in bed. Prof. Pereira keeps the fractured limb immobilized for a very much shorter time than do most American orthopaedic surgeons. He treats a simple fracture of the os calcis by applying a Delbet splint, which is prolonged along the sole of the foot; this apparatus is left on for twenty-five days, at the end of which time it is removed and walking is begun.

In general his views on dislocations and their methods of reduction are in accord with the modern American practice.

The book, in general, is reasonably complete and well illustrated. Some of its readers may object to many of the methods of treatment advocated, but it presents some very stimulating ideas. The book is a definite contribution to the literature of the Spanish-speaking doctors of the Americas who have to deal with fractures, and it contains much that is new to the average American orthopaedic surgeon.

TRAUMATOLOGY AND ORTHOPAEDICS. Edited by Prof. V. D. Chaklin. Sverdlovsk, Ural Institute of Traumatology and Orthopaedics, 1938.

This book presents six monographs published by the Ural Institute of Traumatology and Orthopaedics. The subjects are not correlated, but are of vital orthopaedic

interest. They include pathological changes and reparative processes in fractures of the bodies of the lumbar vertebrae, histopathology and clinical course of pseudarthroses of the leg, osteochondropathy of the carpal lunate, short postamputation stumps of the arm, prostheses, and injuries of the peripheral nerves of the upper extremity.

Each monograph presents the results of a thorough personal study of extensive material in an institution under able organization. Some of the articles are based on experimental and clinical observations; others treat clinical material only. Each one is amply illustrated, although, unfortunately, the illustrations are printed unsatisfactorily and do not compare favorably with the text. Each monograph may be regarded as a definite contribution to the subjects under consideration and should be taken into account by any writer contemplating a study of these problems.

THE ORGANISM. A HOLISTIC APPROACH TO BIOLOGY DERIVED FROM PATHOLOGICAL DATA IN MAN. Kurt Goldstein, M.D. With a Foreword by K. S. Lashley. New York, American Book Co., 1939. $4.00.

This volume in the American Psychology Series is an English translation of the work first published in German, in Amsterdam, in 1934. It is based on Dr. Goldstein's experiences during the World War in the care of patients with brain injuries and has been continued by him as an expatriate in Holland and in America. Prof. Lashley, of Harvard, in his foreword points out that the theme of the volume is the conception of behavior as a result of a unified activity of the organism and that the work is of prime importance for all branches of natural science which are concerned with the correlation and integration of vital functions. In considering the problems of human conduct, the author discusses the familiar theories of behaviorism, Freudism, and the form psychology of Koehler. However, he considers none of these adequate, but undertakes to combine elements from them all in a theory of behavior as a manifestation of all the factors of integrated personality. He thus constructs a holistic approach to biology derived from the pathological details of brain injuries and disturbances. He almost approaches, from a scientific standpoint, the mystical concept of the human spirit, but he makes no claim, as yet, for its scientific demonstration, if indeed such demonstration can be ever possible. It is a significant and thoughtful work and deserves serious consideration by all students and teachers of psychology.

THE MEDICAL ANNUAL 1939. Edited by H. Letheby Tidy, M.A., M.D., F.R.C.P., and A. Rendle Short, M.D., B.S., B.Sc., F.R.C.S. Bristol, John Wright & Sons Ltd., 1939. 20 shillings.

One of the numerous recommendations of this year book is that the current issue is the fifty-seventh yearly edition. Longevity in itself might not establish worth, were it not that its predecessors, through the years, have assumed the position of a medical bible to the physicians of the British Empire. Yearly, within its covers, the family doctor finds in compact form a résumé of the latest worth-while developments in medicine, surgery, and research. In fact, the subject matter is so comprehensive that one can scarcely find a condition which is not mentioned at least briefly.

The present edition, with 660 pages of text, 124 text illustrations, and 72 plates, plain or colored, is augmented by a practitioner's index of new pharmaceutical and dietetic preparations, medical and surgical appliances, etc. This is followed by a list of the principal medical books and scientific periodicals of the year, covering every phase of medicine and surgery.

The subject matter of the text has been prepared by thirty-seven of England's leading physicians and surgeons, each contributor covering the field in which he excels. Subjects are taken up alphabetically. Should one tire of air-raid and bedbug precautions, he may turn to the more intriguing chapters on childhood diseases by Sir John Fraser or pruritus ani by J. P. Lockhart-Mummery. Although the contents are diversi-

fied, and at times of necessity brief, there is much of value for the practitioner or the specialist. In general, the reader is told what to do for a condition rather than how to do it. Undoubtedly, the book's value is greatly increased when used in conjunction with the volumes which have preceded it. By itself, it will prove of worth as a guide to the latest and best in the medical world of today.

DISEASES OF THE NOSE AND THROAT. Charles J. Imperatori, M.D., F.A.C.S., and Herman J. Burman, M.D., F.A.C.S. Edition 2, Revised. Philadelphia, L. B. Lippincott Co. 1939. $7.00.

This is not just another textbook on the nose and throat. The authors have fortunately avoided incorporation of most of the dogma that is commonly copied from one textbook to the next. By the use of outline format, brevity is obtained, so that the entire field of otolaryngology is dealt with in rapid and adequate fashion. After a description of the examination of the patient, the diseases of the nose, septum, sinuses, nasopharynx, mouth, larynx, trachea, bronchi, lungs, and oesophagus are taken up. There are many other chapters covering peroral endoscopy, physical therapy and radiation, allergy, manifestations of general diseases, and laboratory aids. For each condition the symptoms, diagnosis, and treatment are first discussed. The treatment described is modern and practical. Old and rare types of therapy are omitted. Considerations of the pathology and etiology complete each discussion. Developmental anatomy, physiology, and examination methods are dealt with according to the various divisions of the book, which makes it very usable. The illustrations are well chosen, many being original. A bibliography would be welcomed by the advanced student. This book is clearly and simply written and the subject is handled in a practical manner. Any practitioner or student in this subject will be benefited by study of this excellent text.

VERHANDLUNGEN DER DEUTSCHEN ORTHOPÄDISCHEN GESELLSCHAFT. DREIUNDDREISSIGSTER KONGRESS IN GIESEN. (Beilageheft der Zeitschrift für Orthopädie und ihre Grenzgebiete, LXIX.) Stuttgart, Ferdinand Enke, 1939. 28 marks.

The Thirty-Third Congress of the German Orthopaedic Society was held in Giesen under the leadership of Prof. Peter Pitzen on October 3, 4, and 5, 1938. The transactions were published with Dr. Max Brandes as Editor. The first day opened with a discussion of orthopaedic surgery as related to the workingman and to the Greater German Reich. The functional adequacy of musculature and constitutional factors were discussed, along with ways of measurement of the physical ability of the individual to work. Industrial injuries to the locomotor apparatus become a problem in preventive medicine as well as in therapeutics. Under the heading of "Orthopaedic Technique", a variety of apparatus was discussed. On the second day the time was divided between an excellent symposium on the relationship of gynecology to orthopaedic surgery and the subject of primary bone tumors. Problems of heredity were discussed with special relation to congenital deformities. Miscellaneous subjects included vitamins and hormones, scoliosis, and pelvic tuberculosis.

SPORTS FOR THE HANDICAPPED. George T. Stafford, Ed.D. New York, Prentice-Hall, Inc., 1939. $2.50.

"This book aims to present to the physical educator, the school nurse, the physician, the handicapped, the parent, and all who are concerned with the education of the handicapped, a method of teaching that will motivate the atypical student to improve not only his physical condition, but also his outlook on life. This method of teaching is offered after twenty years of experience in teaching handicapped individuals." This statement from the preface leads one to hope for a solution of this perplexing problem. However, from the medical standpoint, the reviewer feels that this goal has not yet been attained.

Although the author is not a physician, a large portion of the book is concerned with the discussion of various orthopaedic and medical problems which result in disability. Consequently, some of the discussions are rather confused, and there are numerous misstatements of fact.

In his selection of sports for the handicapped, the author's principle appears to be that no change be made in the rules of the sport chosen, but that the handicapped individual be allowed to participate to the best of his ability. Lists of sports which are suitable for various physical handicaps are given. Such information is undoubtedly helpful when used in conjunction with medical advice. Since it is probable that injudicious participation in these sports may be harmful in a good many instances, this reviewer feels that the selection of proper sports should be left to the patient's attending physician.

DIE GESCHICHTE DER DEUTSCHEN ORTHOPÄDISCHEN GESELLSCHAFT (History of the German Orthopaedic Society). Dr. med. Peter Bade. Berlin, Julius Springer, 1939. 12 marks.

This book will be of interest to those who wish to learn of the beginning and early history of the German Orthopaedic Society and to follow its development from the early period of its existence to the present. Its activities during the World War and the part which it has played in the influence of German orthopaedic surgery since that time have been carefully reported by the author. Considerable space is given to the discussion of the many Congresses, with an account of the subjects presented, the comments on them, and the accomplishments of these meetings. There are excellent photographs of the various presidents, with adequate sketches of each.

The book is recommended to those interested in the history of the development of orthopaedic surgery throughout the world.

THE ART OF ANAESTHESIA. Paluel J. Flagg, M.D. Ed. 6. Philadelphia, J. B. Lippincott Co., 1939. $6.00.

In this book, Dr. Flagg limits his discussion of anaesthesia very largely to inhalation anaesthesia and resuscitation. His discussion of these subjects is sound, and his long experience and, particularly, his valuable work with intratracheal anaesthesia and resuscitation entitle him to speak with authority. His discussion is very conservative, as he advocates such well-seasoned and reliable anaesthetics as ether and gas-oxygen-ether. Much less space is devoted to the more recent anaesthetics and methods. Indeed, intravenous anaesthesia with the barbiturates is hardly more than mentioned, while regional and spinal anaesthesia are frankly only skimmed, and the reader is referred for a consideration of these subjects to Labat's "Regional Anesthesia" and to other works. The descriptions of regional anaesthesia in Labat's splendid book are still authoritative, but, since it was published in 1932, it naturally contains no mention of the numerous developments and improvements in spinal anaesthesia which have taken place since then. Thus, a reader even of both books is left with no adequate conception of present-day spinal anaesthesia.

It seems unfortunate also that in his presentation of the signs of anaesthesia Dr. Flagg has not used the classification of these signs agreed to by most anaesthetists today, while his presentation of the ascending respiratory paralysis of deep ether anaesthesia seems decidedly at variance with that so beautifully demonstrated by Miller with his synchronous pneumograph and concurred in by practically all anaesthetists. Probably few anaesthetists of extensive experience with nitrous-oxide-oxygen anaesthesia will agree with his dictum that the most important sign here is the color of the patient, although all will heartily applaud his insistence that the final criterion is always the patient and not the meters on the gas machine.

On the whole, the anaesthetist who follows this book will find himself on sound ground and in a safe position, although he will be somewhat limited in scope and in choice.

DIE ALLGEMEINBETÄUBUNG NACH IHREM HEUTIGEN STAND (The Common Anaesthetics and Their Present Status). Dr. med. Richard Goldhahn. (Vorträge aus der praktischen Chirurgie, 23. Heft.) Stuttgart, Ferdinand Enke, 1939. 5 marks.

This review of anaesthetics and narcotics is an attempt to give a practical summary of the pharmacological action of the various drugs used as a preliminary to anaesthesia and during anaesthesia. Methods and technique of anaesthesia are not discussed. The book gives a good résumé of the various anaesthetics with graphic charts of the various physiological effects on breathing, blood pressure, skin color, reflexes, etc. The book contains nothing new, but it should be of value in choosing anaesthetics for various surgical procedures.

NUTRITION AND PHYSICAL DEGENERATION. A COMPARISON OF PRIMITIVE AND MODERN DIETS AND THEIR EFFECTS. Weston A. Price, M.S., D.D.S., F.A.C.D. Foreword by Earnest Albert Hooton. New York, Paul B. Hoeber, Inc., 1939. $5.00.

In his preface to this volume, Prof. Hooton, of Harvard, comments on the fact that hitherto we have rather tried to find out why civilized teeth are so poor instead of why savage teeth are so good. The latter is precisely what Dr. Price has undertaken to do, and he has made extensive travels among primitive peoples of Europe, North America, Melanesia, Polynesia, Africa, Australia, New Zealand, and Peru, comparing their diets and their dental conditions with those of people in civilized localities. It is his conviction that it is the change from savage to civilized diet, together with the soil depletion associated with intensive land cultivation, which has led not merely to dental deterioration but to other forms of physical and mental deterioration as well. The work is illustrated with 134 excellent figures and with six maps charting the author's journeys of exploration.

In a final chapter on the practical application of primitive wisdom, Dr. Price points out specific methods by which modern dietaries might be improved in order to recapture some of the physical superiority which primitive savages have owed to their diet.

ERKENNUNG UND BEHANDLUNG DER HIRNSCHÄDELBRÜCHE (The Diagnosis and Treatment of Fractures of the Skull). Dr. med. habil. Remmer Andreesen. (Beihefte zur Monatsschrift für Unfallheilkunde und Versicherungsmedizin, Heft 27.) Berlin, Julius Springer, 1939. 4.50 marks.

This monograph of forty-eight pages is devoted to the problem of fractures of the skull. The material is subdivided into the following groups: fractures of the skull in general, the treatment of closed fractures, fractures in children, the treatment of open fractures, fractures at the base of the skull, the surgical treatment of the sequelae of skull fractures.

The entire subject is covered in a brief but adequate manner, with liberal references to various non-German authorities and excellent roentgenographic reproductions. Although this monograph is not of special interest to the orthopaedic surgeon, it may be appreciated by the surgeon who is interested in skull fractures and who can read German.

STUDIES ON SPONDYLOLISTHESIS. Sten Friberg. *Acta Chirurgica Scandinavica*, LXXXII (Supplementum LV), 1, 1939.

Two hundred and eighty cases of true spondylolisthesis, comprising most of those diagnosed in Sweden from 1927 to 1938 inclusive, were subjected to a thorough statistical and follow-up study. One hundred and eighty-nine of them were personally examined by the writer.

Spondylolysis is attributable to the abnormal development of the neural arch from two osseous centers instead of from one on each side. Familial occurrence was found in a considerable number of cases. Lysis or olisthesis was discovered in 5.6 per cent. of 1834

lumbosacral spines examined roentgenographically. In 10 per cent. of the diagnosed cases there were no symptoms, in spite of the fact that some of the patients did strenuous work.

Follow-up roentgenograms showed a change in the position of the olisthetic vertebra after one to eleven (average three and five-tenths) years in only ten cases and a distinct ventral displacement in only two. In the latter cases the fifth lumbar vertebra was already tilted over the anterior sacral rim when first examined at ten and fifteen years. In 176 cases there was no increase in displacement. The writer believes that slipping does not occur in adult life except for the slight displacement which may result from degeneration and thinning of the intervertebral disc. Operation, therefore, should not be performed in adults to prevent slipping, but may be employed to relieve disabling symptoms. The functional results in forty-four patients who were operated upon were only slightly better after from one to seven years than those in 143 patients who were conservatively treated. However, the original condition of the patients who were operated upon was for the most part worse. There was no direct relationship between the functional result and the roentgenographic appearance of the graft. Good results were obtained when the grafts were "fractured" or reabsorbed, and poor ones were observed when the new bone seemed wholly adequate.—*Walter P. Blount, M.D., Milwaukee, Wisconsin.*

Ruptures of the Tendon Aponeurosis of the Shoulder Joint—the So-Called Supraspinatus Ruptures. Knut Lindblom and Ivar Palmer. *Acta Chirurgica Scandinavica*, LXXXII, 133, 1939.

Ruptures of the supraspinatus tendon or of other parts of aponeurosis of the shoulder joint are usually traumatic, but are due to repeated injuries rather than to a single isolated accident. Roentgenographic visualization of the defect, with the injection of six cubic centimeters of 35 per cent. perabrodil into the shoulder joint, was a help to the writers in determining the degree of tear and the treatment to be employed. Their roentgenographic reproductions show the defects clearly. They conclude that silk suture of the torn tendon to a groove in the greater tuberosity is indicated except in the old cases where the retraction is great.—*Walter P. Blount, M.D., Milwaukee, Wisconsin.*

Paravertebral Aspiration of Tuberculous Psoas Abscess. Frederick C. Warring, Jr., and Edward M. Kent. *The American Review of Tuberculosis*, XXXIX, 338, March 1939.

A technique for the aspiration of a psoas abscess through a paravertebral approach is described. With the patient lying on his side (abscess uppermost), the path of the aspirating needle is anaesthetized with 2-per-cent. novocain in a sterile field. A 15-gauge needle, five and one-half inches long, is then introduced five centimeters in a lateral direction from the spinous processes at the level of the third and fourth lumbar or of the fourth and fifth lumbar spaces. It is directed parallel to the cross section of the body and slightly lateralward until pus is aspirated. The depth of insertion of the needle depends upon the muscular development of the individual; usually it is inserted from three and one-half to five and one-half inches. No air is injected into the abscess cavity. After aspiration, the needle is withdrawn slowly, the needle track is gently massaged, and a sterile dressing is applied. In five aspirations on two patients no swelling or redness at the area of puncture was encountered.

The anatomy of the area with regard to fascial cleavage planes and underlying structures is discussed. The authors feel that the ureter and the spermatic vessels lying in the retroperitoneal space are the only structures liable to injury unless the needle is pushed on into the peritoneal cavity.

The advantages of the method are that the abscess may be drained before it has pointed below Poupart's ligament, and that there is less risk of sinus formation along the needle track than in aspiration at a superficial point.

Two cases of tuberculous spondylitis with psoas abscess in which this method was employed are reported. Up to 600 cubic centimeters of pus was evacuated through this approach at one time. No bad after-effects or complications were seen. Accompanying roentgenograms illustrate the steady decrease in size of the abscess following aspiration. In one case a radio-opaque oil (bismuth subnitrate and iodoform in paraffin oil) was injected following aspiration to observe the effect it might have therapeutically on a closed abscess space. No untoward reaction was noted.

The authors feel that this method should be restricted to that type of abscess which continues to enlarge in spite of adequate treatment of the spinal lesion, and which is in danger of rupturing.—*D. E. Moore, M.D., Iowa City, Iowa.*

L'AZIONE DELL'ORMONE TESTICOLARE SULLA CONSOLIDAZIONE DELLE FRATTURE NEI VECCHI (The Effect of Testicular Hormone on Fracture Healing in the Aged). Renato Mosti. *Annali Italiani di Chirurgia*, XVIII, 281, 1939.

The author describes three cases of fracture in old men, which showed no tendency to callus development, but resulted in osseous union within four weeks after the administration of testicular hormone. Twenty-five to fifty milligrams of testosterone propionate were administered subcutaneously every three or four days for from twenty to thirty days, the total amount being 175 to 500 milligrams. While there is no laboratory or experimental proof of the theory that dysfunction of the testicles delays fracture healing, the practical proof of immediate production of callus in fractures in the aged after injection of testosterone justifies this therapy.—*Josef Wolf, M.D., Davenport, Iowa.*

FRACTURES AND DISLOCATIONS BY MUSCULAR VIOLENCE, COMPLICATING CONVULSIONS INDUCED BY METRAZOL FOR SCHIZOPHRENIA. Louis Carp. *Annals of Surgery*, CX, 107, July 1939.

The attention of the author was called to this subject by the monthly report of the Board of Visitors of the Rockland State Hospital for May 1938, which mentioned a fracture of the neck of the femur in a schizophrenic female, aged thirty years, which had been produced by the muscular violence of a convulsion induced by metrazol.

Statistics of similar injuries were obtained from twenty New York Civil State Hospitals and analyzed. Twelve fractures (1.78 per cent.) and 118 dislocations (17.2 per cent.) occurred in 687 patients who received metrazol therapy one or more times. In every case the injury was produced entirely by the muscular violence of the convulsion.

On the other hand, in convulsions of epilepsy over a three-year period at Rockland State Hospital, where the number of convulsions averaged 213 monthly, no fractures or dislocations occurred.

The statistical data are analyzed in tables giving the age and sex of the patients, the number of convulsions previous to injury, the duration of convulsive seizure, the type of restraint, and the anatomical diagnosis. Also included are data on cases in which insulin was used. Injuries during convulsions from insulin shock were comparatively rare,—thirteen compared with 130 in convulsions produced by metrazol, in spite of the fact that more than twice as many patients were treated with insulin.

In one of the tables are listed the mechanisms of the fractures and dislocations. The author suggests that constitutional inferiority, osteoporosis from disuse, sustained posture, or prolonged undernutrition may be predisposing factors in the production of the injuries. The above-mentioned factors, plus the fact that convulsive seizures produced by metrazol are the most violent ever recorded in human beings, adequately explain the injuries.

The most frequent injury was dislocation of the mandible which occurred 105 times. Dislocation of the head of the humerus occurred fifteen times. Intracapsular fractures of the neck of the femur occurred three times, and intertrochanteric fractures occurred twice. Compression fracture of the body of the seventh dorsal vertebra occurred once.

In order to minimize injuries, the author suggests that forceful restraint be used as little as possible. Pressure of the hand upward against the mandible tends to prevent dislocations. By holding the arms close to the trunk, dislocations of the shoulder can be prevented.—*O. B. Bolibaugh, M.D., San Francisco, California.*

THE USE OF VITALLIUM AS A MATERIAL FOR INTERNAL FIXATION OF FRACTURES. Willis C. Campbell and J. S. Speed. *Annals of Surgery*, CX, 119, July 1939.

The authors believe that the majority of fractures can and should be treated by closed methods, but that there are certain fractures in which internal fixation is definitely indicated. The introduction of vitallium, an alloy which is practically inert, as a means of internal fixation has been one of the outstanding contributions in bone surgery.

The present report is based upon the study of sixty-five cases in which vitallium was used in the form of plates or screws, or both, as means of internal fixation in fractures.

The authors emphasize the importance of proper preoperative preparation and operative technique. They advise against operation immediately after the removal of a plaster cast.

Vitallium plates were used in twenty-two acute simple fractures during the past year with results unquestionably superior to those obtained previously with other materials. There has been no absorption of bone about screws nor any inflammatory changes in the tissues. Eight plates were removed after periods varying from four to ten months with no evidence of corrosion or tarnish.

In twelve cases of delayed union or cases where osteotomy was performed for malunion, vitallium plates were used with excellent results. In cases of this kind, where the quality of bone is poor and stimulation of osteogenesis is necessary, autogenous bone grafts are recommended.

In typical ununited fractures, the authors advise the use of autogenous bone grafts. However, they have used vitallium screws to provide firmer fixation for autogenous grafts in nineteen cases and have not observed any deleterious effects.

Eight acute compound fractures, seen within twelve hours after injury, were plated. These cases were selected. They were compounded from within and there was relatively little damage to the soft tissues. The wounds were thoroughly débrided, and cleansed with copious irrigations of normal saline solution. After plating, the wounds were partially closed and a plaster cast or splint was applied. Sulfanilamide was given as a prophylaxis. In this group, the wounds healed primarily, and no infection has developed. All plates are still *in situ*.

In cases of compound fractures with extensive damage to the soft tissues seen later than twelve hours after injury, the above procedure was carried out and in addition incisions were made for Dakin tubes. Suitable immobilization was used. In this group only mild infections occurred which were controlled by the Dakin treatment.

Vitallium plates maintain firm fixation, do not interfere with the process of callus formation, and in certain instances can be used to advantage even in compound fractures.

O. B. Bolibaugh, M.D., San Francisco, California.

TRAUMATIC MYOSITIS OSSIFICANS. REPORT OF A CASE FOLLOWING FRACTURE AT THE ELBOW. Samuel Kleinberg. *Annals of Surgery*, CX, 144, July 1939.

The author reviews briefly the development of the modern conception of the treatment of joint injuries and reports a case of myositis ossificans following a fracture of the external condyle of the left elbow in a child of five years.

Myositis ossificans developed in this case as a result of forced, passive exercises carried out by the parents who feared the child would have a stiff elbow.

This case was seen by the author three months after the injury. The arm was completely immobilized for six weeks. No subsequent treatment was given, and use of the arm was encouraged. In three months the child had seventy degrees of voluntary motion and most of the calcium deposit had been absorbed.

The author advises against forcible passive motion following joint injuries. In cases where myositis ossificans occurs, he recommends complete rest by immobilization until all pain and swelling subsides.—*O. B. Bolibaugh, M.D., San Francisco, California.*

DIE REGIONÄRE VERBREITUNG DER LUXATIO COXAE CONGENITA (The Regional Distribution of Congenital Dislocation of the Hip). B. Valentin. *Archivio Italiano di Chirurgia*, LIV, 791, 1938.

The author presents a study of the geographical distribution of congenital dislocation of the hip in relation to the various national groups. The study is based on the author's personal investigation in the province of Hannover, Germany, where out of 29,616 cases of infirmities, observed between 1925 and 1935, 1,216 were cases of congenital dislocation of the hip. There are extensive citations and references concerning the distribution of congenital dislocation of the hip in several European countries, in North and South America, in Japan, in China, and in Africa. The purpose of this work is to present a comprehensive view of the contemporary status of the subject, in order to clear the way for further progress and understanding of this complicated problem in which habitat, racial intercrossing, disease, and other correlated elements have a part.—*Emanuel Kaplan, M.D., New York, N. Y.*

DIAFISECTOMIA TOTAL DE LA TIBIA POR OSTEOMIELITIS AGUDA (Total Diaphysectomy for Acute Osteomyelitis of the Tibia). Pedro V. Pedemonte. *Boletín de la Sociedad de Cirugía de Montevideo*, IX, 345, 1939.

Some surgical procedures are received with a great deal of difference of opinion by various surgeons, and total diaphysectomy is one of these.

The author reports a case of total diaphysectomy, which he observed over a long period of time. The patient, a boy, ten years of age, was stricken with an acute osteomyelitis, which came on simultaneously in two sites,—the tibia and the humerus. The child was extremely sick at the onset of the disease, and abscesses formed at both foci. Although these abscesses were drained, the patient did not improve, and, after about a month, a total diaphysectomy of the tibia was done. Following this, the patient immediately began to improve and continued to improve steadily thereafter. About ten months after the operation, he was allowed a weight-bearing plaster boot, and both foci finally healed. At the end of a year, a very serviceable new tibia, similar in every respect to the old one, had grown. In this case, total diaphysectomy proved to be a very valuable procedure and probably saved the patient's life.

The author quotes the statistics of Sorel and Guichard, who reported a series of twenty-one diaphysectomies with complete and rapid regeneration of the bone in sixteen. In only five cases was it necessary to do a subsequent operation for the placing of a bone graft.

Diaphysectomy makes postoperative dressing easier both for the patient and for the doctor, and is an economical method of treating osteomyelitis. The greatest danger is the non-formation of a new tibia, but this seldom occurs. The operation is much more dangerous in adults than in children, because the power of regeneration of bone in the former is not nearly as good as in the latter. It was first thought that the ideal time to do a total diaphysectomy was during the first few days of the disease, but it now appears that it may be done a good deal later with favorable results. The author stresses the importance of preserving the periosteum intact, for he believes that from this periosteum most of the regeneration originates.

The indications for this procedure are not clearly defined. Some writers believe with Sorel and Guichard that this procedure is indicated in all cases of osteomyelitis in which a large amount of bone destruction occurs, and that it should not be employed in those cases with a bad prognosis or with extensive damage. Others, however, believe that the method should be used only in the latter group.—*Louis W. Breck, M.D., El Paso, Texas.*

CALCIFICATION OF THE COSTAL CARTILAGES. John B. King. *The British Journal of Radiology*, XII, 2, 1939.

Calcification of the costal cartilages is a subject of interest, since, with the possible exception of the pharyngeal cartilages, it is unique in showing ossification taking place throughout adult life. Contrary to commonly accepted views, it is demonstrated that the calcification is not perichondral, but central, and is in the nature of a true ossification. This ossification is unrelated to disease or to habitus, although disease may play a part by interfering with the normal blood-calcium balance. It is indicated that calcification of the costal cartilages is a physiological response of a connective tissue to the strains imposed upon it by muscle action, and it is suggested that, in man, the ossification of the rib cartilages may be a reaction toward greater rigidity of the anterior chest wall following the assumption of the upright posture.—*M. Mendelsohn, M.D., Iowa City, Iowa.*

ADOLESCENT DEFORMITIES OF THE ACETABULUM. AN INVESTIGATION INTO THE NATURE OF PROTRUSIO ACETABULI. John Gilmour. *The British Journal of Surgery*, XXVI, 670, April 1939.

Cases of protrusion of the acetabulum are divided into two groups. The primary cases are adolescent in origin, and the secondary cases are the result of destructive diseases of the hip joint or injury to the acetabular floor. The deformities and disabilities vary according ‘ › the depth of the acetabulum. The writer cites eleven primary cases and one secondary case which he has studied personally. The protrusion may be unilateral or bilateral.

Secondary postural deformities arise from irritation of the joint with resulting muscle spasm. These deformities are due to hip flexion, forward tilting of the pelvis, and lumbar lordosis, and result in an alteration of posture and gait. Non-operative treatment will overcome the contractures around the hip. Early manifestations of osteo-arthritis may be overcome by rest in bed and traction. When the joint surfaces have become irregular, fixation in plaster is advised to encourage ankylosis.

Operative procedures are indicated when the non-surgical measures fail and when there is limitation of movement by contact of the femoral neck on the acetabular rim. "Acetabuloplasty", as devised by Smith-Petersen, is the procedure recommended to remove the bony contacts and a portion of the sensitive joint capsule. This consists in the removal of the margin of the acetabulum which forms the anterior half of the roof and the anterior lip, along with the capsule which lies in front of the femoral neck. The writer has performed this operation in a recent case.—*Ernest M. Daland, M.D., Boston, Massachusetts.*

THE RELATIONSHIP OF ACETABULAR DEFORMITY TO SPONTANEOUS OSTEO-ARTHRITIS OF THE HIP-JOINT. AN INVESTIGATION OF THE INTRA-ARTICULAR FACTORS WHICH PREDISPOSE TO OSTEO-ARTHRITIC DEGENERATION. John Gilmour. *The British Journal of Surgery*, XXVI, 700, April 1939.

By the injection of iodized sperm oil into the hip joint, Gilmour has studied the movement of the fluids within a normal joint. "In acetabular deformities there is a loss of function and an interference with the operation of the fluid mechanism which is proportional to the increase in acetabular depth. Osteo-arthritic degeneration develops whenever this fluid mechanism is impaired, and is accelerated by trauma, superadded infection, and any remote cause which lowers the vitality of the individual."—*Ernest M. Daland, M.D., Boston, Massachusetts.*

THE CLOSED OPERATION FOR INTRACAPSULAR FRACTURE OF THE NECK OF THE FEMUR. FINAL RESULTS IN RECENT AND OLD CASES. Thomas King. *The British Journal of Surgery*, XXVI, 721, April 1939.

This is a study of fifty consecutive fractures treated within three weeks of injury and thirty cases treated later than three weeks after injury. All of these were followed for at least one year.

In the recent fractures bony union was obtained in 74 per cent. of all cases, or in 90 per cent. of patients surviving and followed. Degenerative changes in the head of the femur followed bony union in 28 per cent. The nail failed to hold in four cases (8 per cent.).

In the cases treated after three weeks, spoken of as "ununited fractures", osseous union occurred in 64.3 per cent. of all cases. Excluding deaths in the first year, this figure rises to 82 per cent. Non-union occurred in 14 per cent. of this total group. Head necrosis and osteo-arthritis developed in four cases (29 per cent.).

The Smith-Petersen nail was used alone in the fractures of recent origin. However, the writer now advises the use of a fibular graft along with the nail in all recent cases, and the fibular peg without the nail in older cases. He also does a Pauwels wedge osteotomy below the greater trochanter in the fractures treated late.—*Ernest M. Daland, M.D., Boston, Massachusetts.*

DETACHMENT OF THE MEDIAL EPICONDYLE OF THE HUMERUS WITH DISPLACEMENT INTO THE ELBOW-JOINT. E. J. Radley Smith. *The British Journal of Surgery*, XXVI, 785, April 1939.

Thirty-two cases of this complication of humeral fractures are cited. Thirty cases were treated by open operation, some by nailing and the others by suture. The results of operation were almost uniformly good.—*Ernest M. Daland, M.D., Boston, Massachusetts.*

INCREASED AND DECREASED DENSITY OF BONE WITH SPECIAL REFERENCE TO FIBROSIS OF THE MARROW. H. A. T. Fairbank. *The British Journal of Surgery*, XXVII, 1, July 1939.

Ossification in membrane, unlike that in cartilage, has no intermediate stage of calcification. Heterotopic ossification is usually preceded by calcification of fibrous tissue. The writer endeavors to demonstrate that the presence of fibrous tissue in the medullary spaces is a precursor of ossification, sometimes excessive in amount, in many pathological conditions of the skeleton. The question is raised as to the nature of osteoporosis, osteopetrosis, disuse bone atrophy, and "marble bones".

Generalized osteoporosis occurs in osteogenesis imperfecta cystica, infantile scurvy, osteomalacia, coeliac rickets, renal rickets, and senile osteoporosis, as well as in hyperparathyroidism. In many of these conditions an excessive fibrosis of the marrow has been observed.

Increased density of the bone occurs in diffuse fibrosis of bone, generalized diffuse fibrosis of bone, melorheostosis, generalized osteopetrosis or "marble bones", leontiasis ossea, osteopoikilosis, osteitis deformans, and in secondary growths. In many of these there are areas of increased density and decreased density in the same bone.

In some of these conditions the writer believes that the dense fibrosis in the bone marrow continues into the bone as a fibrosis of the bone itself with a dense deposit of calcium in the fibrous tissue.—*Ernest M. Daland, M.D., Boston, Massachusetts.*

CONGENITAL ABSENCE OF THE RIGHT FEMUR. Kamalakar Manohar. *The British Journal of Surgery*, XXVII, 158, July 1939.

This is a case report of a patient, fifty-two years of age, who came to post-mortem examination. Before death the patient had lived an active life and had gotten about by hopping on the good leg, with a pole for support on the defective side.

The femur was completely absent, with no joint cavity in the acetabulum. There was no knee joint. The muscles showed a mixture of thigh muscles and leg muscles. The psoas and iliacus muscles were small and ended in a tendon attached beneath the inguinal ligament. The tensor fasciae latae, the pectineus, and the gracilis had their usual origins, but their attachments were in the lateral ligament. The vasti, the hamstring muscles, and the popliteus were absent; the adductors were attached to the tibia.—*Ernest M. Daland, M.D., Boston, Massachusetts.*

CONGENITAL DEFECT OF THE SHAFT OF THE FEMUR. H. H. Langston. *The British Journal of Surgery*, XXVII, 162, July 1939.

The writer describes the cases of a boy of nine who had been observed since infancy, a girl of ten, and a girl of eight. All showed normal lower ends of the femora, but the upper ends were either absent or rudimentary. The cause of the deformities is not known.—*Ernest M. Daland, M.D., Boston, Massachusetts.*

TREATMENT OF ACUTE SPRAINS BY PROCAINE INFILTRATION (Seriche's Method). E. J. Moynahan. *British Medical Journal*, I, 671, April 1, 1939.

The author subscribes to the theory of Leriche that a joint sprain is a nervous reflex with vasomotor disturbances following trauma, rather than an actual ligamentous tear. According to this hypothesis, the joint effusion resulting from the reflex vasodilatation contains substances which still further stimulate the nerve endings, establishing a "vasomotor disequilibrium". In normal individuals, the disequilibrium takes from eight to ten days to return to normal, but in individuals possessing an abnormal sympathetic nervous system the condition persists, giving rise to the "chronic sprain". Working on this basis, the author has used procaine infiltration to block afferent impulses, with the view to early restoration of the equilibrium.

A solution of 2-per-cent. procaine, containing one in 40,000 adrenalin, was injected into the periarticular tissues in amounts from ten to fifteen cubic centimeters. Immediate relief of pain and swelling followed, and mobility returned. Several hours later an "after-pain" usually appears, remaining for from four to seven hours and leaving in most cases little disability in the injured joint. This "after-pain" is often very severe. The author believes it may be due to the adrenalin. In some cases the injection must be repeated, and occasionally more than two injections may be required. Campbell of Dundee Infirmary has relieved pain by the injection of normal saline.

Three typical case reports of severe ankle sprains are presented, in which pain, swelling, and disability were alleviated the day after treatment.

In a series of seventeen cases of acute ankle sprains, treated with procaine, there was an average period of disability of two and one-tenth days as compared with twelve cases, treated by ordinary conservative rest measures, in which there was an average disability of ten and two-tenths days.—*Donald E. Moore, M.D., Iowa City, Iowa.*

L'OSTÉOSYNTHÈSE METALLIQUE CHEZ L'ENFANT (Metallic Osteosynthesis in Children). J. Verbrugge. *Bulletin de la Société Belge d'Orthopédie*, XI, 126, 1939.

Verbrugge concludes from a study of 337 cases in which metallic osteosynthesis was done in children that this procedure is not contra-indicated in children. There was no mortality, and no important complications were noted. Functional activity was accelerated, and the inconvenience of certain orthopaedic treatments was avoided. The metal was always well tolerated, but rustless steel was preferred.

In the same symposium, Massa, in a series of 350 fractures in children, compared the results of non-operative treatment with those obtained by metallic osteosynthesis. Observations were made from one to thirteen years after fracture. Good functional results often followed incomplete reduction. In cases in which bad results were obtained, the fracture sites, in the order of frequency, were as follows: elbow, forearm, femur, and tibia.—*John G. Kuhns, M.D., Boston, Massachusetts.*

CALCIUM AND PHOSPHORUS METABOLISM IN OSTEOMALACIA. VII. THE EFFECT OF ULTRAVIOLET IRRADIATION FROM MERCURY VAPOR QUARTZ LAMP AND SUNLIGHT. H. I. Chu, T. F. Yu, K. P. Chang, and W. T. Liu. *The Chinese Medical Journal*, LV, 93, Feb. 1939.

This study was designed to observe (1) the effect of ultra-violet irradiation on the phosphorus and calcium metabolism in osteomalacia and tetany; (2) to compare its effect

with vitamin-D administration; and (3) to evaluate the effect of ultra-violet irradiation from the sunlight with special reference to the part it plays in prophylaxis as compared with vitamin-D efficiency.

Four Chinese women with osteomalacia and one boy with tetany were studied for two months in the metabolism ward. Quantitative diets were served, and the food was analyzed for calcium, phosphorus, and nitrogen. Urine and stools were collected in periods of four days each. The diets were designed to include adequate colonic value and protein content with minimal vitamin D and low calcium, but a moderate amount of phosphorus.

Three cases of severe osteomalacia were treated with ultra-violet irradiation from an air-cooled mercury quartz lamp, and one case of osteomalacia and the case of tetany were treated with sunlight. In all cases marked clinical improvement followed the treatment. Pain and signs of tetany disappeared promptly. Bedridden patients were able to walk at the end of the observation period. Roentgenographically the deposition of bone salts was evidenced by increased density of bone and union of the pathological fractures. The disturbance of calcium and phosphorus metabolism was specifically corrected by the ultra-violet irradiation. The effect of ultra-violet irradiation on the calcium and phosphorus metabolism in cases of osteomalacia was practically identical with that of vitamin-D administration.—*J. H. Burt, M.D., Iowa City, Iowa.*

"Os purum" y su empleo como elemento biologico de protesis interna ("Os Purum" and Its Use as a Biological Agent in Internal Fixation). Jorge de Romaña. *Gaceta Peruana de Cirugía y Medicina*, I, No. 11, 1, 1939.

The author points out the disadvantages of ordinary metallic internal fixation, and describes a method of internal fixation by means of bone plates and screws made of os purum. The paper is based on the work of Orell, who has used os purum not only in the treatment of fractures but also in reconstructive surgery, in plastic surgery on bones, and in tuberculosis.

The plates and screws which the author uses are made with a special die, which cuts threads on the bone pegs. At operation, when the bone plate is applied, a tap, which matches the die, is employed to cut threads in the bone of the host. His method of preparing the os purum is essentially the same as that of Orell, except that he uses steam sterilization of the bone for thirty minutes at a temperature of 120 degrees centigrade.

The author reports three cases of fractures treated in this way: the first was a fracture of the shaft of the femur, with malunion; the second, a recent fracture of the jaw; and the third, a fracture of the upper end of the femur. He states that the cases are too recent to quote any final result, but he is quite enthusiastic about this method of treatment.

In conclusion, the author stresses the fact that this method of internal fixation is essentially a biological method of treatment, inasmuch as the bone plate is the matrix for new bone at the fracture site. Os purum has the further advantage that it does not have to be removed subsequently.—*Louis W. Breck, M.D., El Paso, Texas.*

After-Treatment of Poliomyelitis. K. G. Hansson. *The Journal of the American Medical Association*, CXIII, 32, July 1, 1939.

The virus of anterior poliomyelitis produces varying degrees of damage to the anterior horn cells. By muscle grading after the soreness has disappeared, one is able to determine the extent of the paralysis, but not the severity. Each case, however, should be given full treatment in the expectation of an ultimate return to near-normal muscle power.

The importance of rest and of protection of these weakened muscles has recently been neglected. This has been due, in part, to the enthusiasm for helping the victims of infantile paralysis which has developed and has led to overemphasis on activities.

From Australia has been reported "Sister Kenny's" method, which consists of treating acute poliomyelitis by early passive movements and hydrotherapy. The reeducation exercises begin within one week after the onset of paralysis. The author believes that this method is not rational, and he prefers to treat paralysis due to disease as one would treat any other lower-neuron paralysis. The weakened muscles are protected by splints and braces to prevent their being stretched, and underwater exercises are given as indicated. Circulation may be stimulated by the application of paraffin and by pressure-suction treatment.

Fifty-four cases of poliomyelitis were treated by underwater exercises and all were followed for over three years. The author compares his results to those of cases treated in dry gymnasium. He concludes that there is little difference in percentage of muscle recovery by the underwater method and that of dry exercises. There are, however, definite advantages to be gained by pool exercises,—relaxation of the antagonistic muscles by the moist heat, a mild form of massage due to the motion of the extremity through the water, the increased security felt by the patient when supported by the water, and the conversion of a series of monotonous exercises into a pleasant activity.—*H. M. Childress, M.D., Jamestown, New York.*

HEREDITARY OSTEOCHONDRODYSTROPHIA DEFORMANS. A. Wilmot Jacobsen. *The Journal of the American Medical Association*, CXIII, 121, July 8, 1939.

A report is made of a family in five generations of which twenty members were affected with hereditary osteochondrodystrophia deformans. In this disease the eventual deformities are dependent upon the pattern which the perverted cartilage-growth follows. The cases reported are of a type commonly referred to as Morquio's disease. The vertebral bodies of the four cases studied were wedge-shaped, oval, or otherwise irregular and deformed. The patients were apparently normal at birth, but at the age of five or six years the vertebral changes had become sufficiently developed to be noticed by the parents. The condition was slowly progressive in each case.

Typical deformity in Morquio's disease consists of shortening of the spinal column and of the necks of the femora. The patient is moderately dwarfed, with pigeon breast, kyphosis, and compensatory lordosis. The condition is thought to be a sex-limited inheritance carried through the female.—*Brandon Carrell, M.D., Dallas, Texas.*

SIMPLIFIED INTERNAL FIXATION OF INLAY AND ONLAY BONE GRAFTS. O. L. Miller. *The Journal of the American Medical Association*, CXIII, 635, Aug. 19, 1939.

Preparation of the host fragments of bone for the reception of a graft, with the fitting of the graft in an ununited fracture, is often a tedious procedure. When an inlay or onlay graft is used, provision must be made to hold the graft securely. The author has found that short removable Kirschner wires offer the simplest and most efficient means of graft fixation.

The nails, usually four or five, are placed parallel, and they should come out directly through the center of the incision. The pins are left in for from ten to twelve weeks. No complications have arisen in a fair-sized series of cases, although one graft was absorbed. This apparently was due to some metabolic defect in the tissues.—*Brandon Carrell, M.D., Dallas, Texas.*

ENVIRONMENTAL FACTORS IN RHEUMATOID ARTHRITIS. A STUDY OF THE RELATIONSHIP BETWEEN THE ONSET AND EXACERBATIONS OF ARTHRITIS AND THE EMOTIONAL OR ENVIRONMENTAL FACTORS. Stanley Cobb, Walter Bauer, and Isabel Whiting. *The Journal of the American Medical Association*, CXIII, 668, Aug. 19, 1939.

Rheumatoid arthritis is frequently associated with complaints of constitutional, vasomotor, and neurological disturbances. These symptoms may precede the articular involvement. Specific examples of such occurrences have been recorded in the litera-

ture in which this form of arthritis appeared immediately after some major emotional experience.

Fifty patients were studied by the authors to determine if there existed any close relationship between social factors and arthritic symptoms. Each patient was interviewed by a psychiatrist or a social worker. A life chart was made of each patient. A control group of twenty-five patients with varicose ulcers was also surveyed by this same method.

The conclusions reached were: environmental stress—especially poverty, grief, and family worry—seems to have more than a chance relationship to the onset and exacerbations of rheumatoid arthritis; more detailed psychiatric study, however, is necessary to bring out positive proof of such relationship.—*H. M. Childress, M.D., Jamestown, New York.*

AMPUTATION STUMPS OF THE LOWER EXTREMITY. Paul C. Colonna and Frederick vom Saal. *The Journal of the American Medical Association,* CXIII, 997, Sept. 9, 1939.

A follow-up study of seventy cases of amputation of the lower extremity is reported in this paper. Factors which made amputation necessary were severe trauma, congenital deformities, infectious processes, malignant tumors, and vascular occlusions.

An ideal stump should be conical and smaller than the opposite extremity. In the thigh one should conserve all the length available above the femoral condyles. The Callander type of thigh amputation gave satisfactory results in the six cases in which it was used. In the leg the site of election is about seven inches below the knee joint. The fibula should be entirely removed if the stump is less than five inches in length. The aperiosteal method described by Kirk should be followed. Amputations proximal to the metatarsals are, as a rule, unsatisfactory. Alcohol injections into the nerves are desirable, since none of the patients so treated had any resultant neural complication. Some form of splinting is advisable in leg amputation in order to prevent flexion deformity of the knee. Shrinker bandages should be applied to the stump as soon after the operation as possible.

The authors also point out the value of fusing the proximal tibial and fibular epiphyses when leg amputations in children are done. If the stump is seven inches in length at the time of operation, it may be considerably longer when the patient reaches maturity. The bone usually grows more rapidly than the soft tissues, with the production of a painful stump across which the skin is tightly stretched. By epiphyseal fusion the optimal length is retained.—*H. M. Childress, M.D., Jamestown, New York.*

ANTERIOR DISLOCATION OF THE SHOULDER JOINT. C. H. Gray. *Lancet,* I, April 22, 1939.

The author has studied the anatomy of dislocated shoulders of cadavera and discusses methods of treatment, after-treatment, and complications of these injuries. His conclusions are as follows:

Anatomy: In the anteriorly dislocated shoulder the capsular tear is overshadowed in importance by damage to the supraspinatus tendon as it is forced against the coracoid. The infraspinatus tendon is stretched over the glenoid, where it is subjected to great tension, and the circumflex nerve is menaced by compression between the head of the humerus and the neck of the scapula. Fracture of the greater tuberosity occurs frequently.

Treatment: Kocher's method is unsound. The author's routine is roentgenographic examination for possible fracture, tests for nerve involvement, and reduction by traction. If reduction cannot be accomplished by traction, it must be done by open operation.

After-Treatment: The shoulder should be mobilized immediately. Recurrent dislocation is not caused by mobilization after reduction, but by joint damage due to shearing off of the glenoid ligament. In such cases open operation is necessary.

Complications: The supraspinatus-tendon syndrome is a frequent complication. It is treated by an abduction splint or by suture of the tendon if the tendon is completely ruptured. Fracture of the greater tuberosity occurs in 22 per cent. of all dislocations. If displacement takes place, an abduction splint should be applied or open reduction should be done. Palsy of the circumflex nerve is uncommon, and the treatment is by splint and physiotherapy.

Results: Fifteen out of nineteen of the author's cases of anterior dislocation showed complete recovery in twelve days. Seven out of nine cases of anterior dislocation with fracture of the greater tuberosity showed good results and two cases, fair results.—*F. Kugler, M.D., Iowa City, Iowa.*

FIXATION OF THE OSTEOARTHRITIC HIP BY NAILING. B. H. Burns. *Lancet*, I, April 29, 1939.

The author reports twelve cases of severe osteo-arthritis of the hip, which were treated by fixation with a Smith-Petersen nail. He states that the operation is indicated when the patient is over fifty-five years of age, where there is gross limitation of motion, and when pain is excessive. The technique consists in driving a large Smith-Petersen nail through the greater trochanter and the head and neck of the femur into the acetabulum. Ten patients in this series showed good results, one had no relief from pain, and one died.—*F. Kugler, M.D., Iowa City, Iowa.*

SUDECK'S ATROPHY. Norman Little. *The Medical Journal of Australia*, I, 263, 1939.

The author states that the early findings are irregular areas of decalcification, followed by glassy atrophy and conglomerate fusion of bones. Local hyperaemia and decalcification are due to sensory-nerve irritation. Treatment is divided into two phases,—early immobilization and manipulation in the late stages.—*George Miyakawa, M.D., Iowa City, Iowa.*

THE TREATMENT OF RHEUMATOID ARTHRITIS. A. H. Douthwaite. *The Medical Press and Circular*, CCI, 294, March 22, 1939.

In a few mild, acute cases of rheumatoid arthritis, gold treatment will effect a cure while the patient continues his daily occupation. In most cases, however, additional measures are required to give the affected joints complete rest and to build up the patient's resistance. Foci of infection should be found and treated or removed.

Rest should include more than simply putting the patient to bed. Splints for the legs and arms are indicated; these are removed once each day to permit motion. The diet should be adequate, nutritious, and low in carbohydrates. Constipation, which is present in 82 per cent. of the cases, may be controlled by the inclusion of bulky materials in the diet, by the elimination of purgatives, and by the carrying out of abdominal exercises.

Gold is the drug of choice in the treatment, and the results which have been obtained with gold are better than those secured by any other drug previously used.

When the disease has reached a chronic stage and the patient no longer has an active sedimentation rate, then orthopaedic measures to correct deformity and to restore muscle and joint function are in order.—*Herbert E. Hipps, M.D., Marlin, Texas.*

GOUT. REPORT OF NINE CASES WITH NEW ADDITION TO TREATMENT. E. J. Callahan and D. W. Ingham. *Medical Record*, CXLIX, 167, March 1, 1939.

The authors report nine cases and suggest a new treatment. This treatment consists in massive doses of vitamin B, 4500 to 9000 international units of hydrochloride (Betax Winthrop) daily, seven and five-tenths grains of cincophen three times daily, a purine-free diet, and warm mineral baths, supplemented by hot mineral-water packs to the affected joints.

Eight of the nine patients were men between forty-five and sixty-five years of age. The duration of symptoms was from two weeks to six months, and the duration of the disease was from three to twenty years, with the exception of one case in which the patient was treated early during his first attack.

Tophi occurred in only two of the nine cases. In eight cases the phalangeal joints of the first metatarsal were affected, and in one case the ankle joint was involved. There was a history of alcoholic consumption in six of the nine cases. Blood uric acid was available in five cases and in all but one was above normal.

By means of the treatment described, all of the patients were completely relieved within seven days, with no evidence of remaining involvement of the joints. There had been no recurrences at the time of the report. The observation periods ranged from three to eighteen months.—*R. W. Newman, M.D., Iowa City, Iowa.*

Comparative Evaluation of Operative Methods of Treatment of Congenital and Irreducible Dislocations of the Hip. E. A. Lipkina. *Orthopaedia i Travmatologia*, XII, 18, 1938.

The author analyzes material from the Moscow Regional Institute of Orthopaedic Surgery and Traumatology and arrives at the following conclusions: The most widely used operative methods are the shelf operation of König and the osteotomies of Schanz and Lorenz. The Lorenz bifurcation seldom gives good results and is considered irrational. The shelf operation does not produce absolute stability and is effective in the presence of definite indications. The Schanz osteotomy is simpler than the Lorenz bifurcation and affords a good support for the pelvis. Because of the good results obtained with the Schanz osteotomy, the author considers this type of operation as the most rational of the known palliative procedures for irreducible congenital dislocation of the hip.—*Emanuel Kaplan, M.D., New York, N. Y.*

Operative Treatment of Transverse Flat-Foot and Hallux Valgus. J. S. Youssevitch. *Orthopaedia i Travmatolgia*, XII, 31, 1938.

The treatment of the transverse flat-foot deformity may be conservative or operative. The late Prof. R. Vreden proposed several operative methods for the relief of this affliction. In 1931, a new method was introduced, the purpose of which was to approximate the diverging metatarsals and to bind them together with fascia lata. The operation was performed through two incisions,—one, placed on the medial side of the foot; the other, on the lateral aspect. A strip of fascia lata was used; the two ends were introduced in such a manner that one was passed over the dorsum of the metatarsals and the other was drawn under the plantar surface of the metatarsals, just behind their heads. The two ends were sutured tightly together. Subsequent clinical observations proved that fascia was inadequate to hold the metatarsals together. Further observations demonstrated that paraffined silk answered the purpose more satisfactorily.

Fifty patients, or a total of ninety-five feet, have been operated on since 1931 by this method.

The author draws the following conclusions: (1) The operation is justified both from a physiological and from an anatomical point of view; (2) it is simple technically and yields very good results, especially in relieving the discomfort of the patients; (3) the method may be considered to eliminate the factor responsible for the formation of hallux valgus.

—*Emanuel Kaplan, M.D., New York, N. Y.*

Arthroereisis as a Method of Operative Stabilization of a Paralytic Extremity. B. V. Rubinstein. *Orthopaedia i Travmatologia*, XII, 35, 1938.

According to the author, arthroereisis as a method of correction of paralytic deformities is in many respects superior to arthrodesis. He reports the results obtained by arthroereisis at the Central State Traumatological Institute.

Since 1933, fifty-three arthroereises have been performed; of these, twenty-six were on the ankle, six were on the knee, and twenty-one were on the hip joint. The posterior arthroereisis was used on the ankle, the technique being a modification of the method of Guibald and Marchand. The functional end results were appraised after a period of about three years and were considered satisfactory in most of the cases. Serial roentgenograms showed the gradual modification of the grafts and the final formation of a good retaining bone. The posterior arthroereisis was also used in cases of equinus deformity. For valgus and varus deformities, lateral arthroereises, according to the technique of the late Prof. Vreden, were used. The end results were found to be very satisfactory. Roentgenographic examination demonstrated that, in about two years after operation, the grafted bone had the appearance of normal bone. Of the six arthroereises of the knee, one was done according to Campbell's technique; four were carried out by the extra-articular method of Tavernier and Guilleminot; and one was performed after the intra-articular method of the last-mentioned authors. A study of consecutive roentgenograms showed the evolution of the graft into a solid support, and it also demonstrated the importance of heavy solid grafts.

The author finds that arthroereisis is, in general, preferable, as it does not destroy the function of a given joint. The indications for arthroereisis are limited to joints in which some stability is present and in which no plastic operations on the muscles or tendons are possible.—*Emanuel Kaplan, M.D., New York, N. Y.*

ETIOLOGY AND PREVENTION OF THE SO-CALLED CONGENITAL DISLOCATION OF THE HIP. Prof. I. M. Tchijine. *Orthopaedia i Travmatologia*, XII, 92, 1938.

The theory of Lorenz that a child is not born with a congenital dislocation of the hip, but with a predisposition to such a dislocation prompted the author to find ways of establishing an early diagnosis of the so-called congenital dislocation of the hip. The investigation was based on a roentgenographic study of newborn infants. The author describes an important angle formed by a line tangent to the roof of the acetabulum and another line passing through the center of the acetabular cartilage and parallel to a horizontal line. In the majority of newborn infants, the ontogenetic development of the hip joint, appropriate for the function of *homo erectus*, is completed *in utero;* in some cases, however, the development of the acetabulum is not completed until after birth. Every newborn child should be subjected to roentgenographic examination, and, if it is found that the acetabular angle exceeds 40 degrees, an effort should be made to maintain both hips in full abduction and in 90 degrees of flexion until the angle is improved. The improvement of the angle should be ascertained by repeated roentgenograms. The treatment usually takes about nine or ten months.—*Emanuel Kaplan, M.D., New York, N. Y.*

L'OSTÉOTOMIE FÉMORALE D'APPUI DANS LA LUXATION CONGÉNITALE IRRÉDUCTIBLE DE LA HANCHE (Femoral Osteotomy of Support in Irreducible Congenital Dislocation of the Hip). M. Lance. *La Pratique Chirurgicale Illustrée* (Edited by Victor-Pauchet and T. DeMartel. Paris, G. Doin & C^{ie}), XXIII, 217, 1939.

Anyone who has had the opportunity to read *La Pratique Chirurgicale Illustrée* is cognizant of the excellent character of the monographs and appreciative of the delightful and exact manner of illustration by S. Dupret. This monograph, in which Dr. Lance describes a method of femoral osteotomy, deserves the same praise.

In the treatment of congenital dislocation of the hip any one of three varieties of osteotomy may be employed. In the reducible type, in cases of extreme anteversion of the upper extremity of the femur, an osteotomy of derotation may be required. In the irreducible type, the osteotomy of direction may be done to reestablish the normal axis of the femur after a shelf operation, or it may be necessary to perform an osteotomy of support. The latter type of osteotomy is best suited to posterior dislocation of the head of the femur, in which the head cannot be stabilized by a shelf. Experience shows that support may be obtained by angulation of the femur, the support being furnished by the

upper fragment. To effect this, it is necessary to swing the greater trochanter downward after an appropriate osteotomy, and to place the lower fragment so as to obtain an angle open externally. This type is especially successful in unilateral and bilateral dislocations in patients not younger than eighteen years of age. The operation consists of the following steps:

The line of osteotomy is defined on the roentgenogram. An incision is made parallel to the longitudinal axis of the femur and extending upward from the line of osteotomy to three centimeters above the tip of the greater trochanter and downward below the line of osteotomy for a distance of three centimeters. The tendons of insertion of the gluteus medius and the gluteus minimus are defined at the tip of the trochanter and isolated, but are not severed. A very heavy silk is passed under the tendons, and the ends of the silk are temporarily clamped together. The vastus lateralis is then incised below the trochanter longitudinally; the line of osteotomy is defined; and a square joint is formed with the osteotome. This permits angulation of the osteotomized fragments without lateral displacement. The previously inserted silk is pulled forcibly down, thus forcing the greater trochanter downward and the upper fragment inward toward the acetabulum. The ends of the silk thread are then sewed through the vastus lateralis of the distal fragment, forcing the distal fragment inward and upward into the square joint. The incision is sutured, and a plaster-of-Paris spica is applied for fifty days in the case of an adolescent and for sixty days in the case of an adult. Numerous illustrations show explicitly every step of the operative procedure.—*Emanuel Kaplan, M.D., New York, N. Y.*

LES ARTHRITES MICROFILARIENNES DE L'ONCHOCERCOSE AFRICAINE (Arthritis Due to the Microfilaria of African Onchocerciasis). L. Déjon. *La Presse Médicale*, XLVII, 983, June 21, 1939.

Arthritis caused by this microfilaria is practically unknown. The author reports three cases, the first of which was originally recorded in 1931. The author believes the condition is more common than the paucity of reports would indicate. This he attributes to the difficult conditions under which the cases are studied.

The diagnosis is readily established by the presence of the embryo filaria in the fluid aspirated from the joint. It is to be noted that the examination must be made immediately after the aspiration. The number of filariae present in the specimen seems to diminish rapidly with each succeeding aspiration. In the hanging-drop preparation, the microfilariae are readily recognized as actively motile organisms, about 250 to 300 centimeters long and seven millimeters wide, without an enveloping capsule. The identification is completed by differential staining and by the presence in the patient's skin of parasitic cysts.

Clinically, the author has observed a hydro-arthrosis of the knee, an acute arthritis of the knee, and an acute arthritis of the hip. The onset may be gradual or sudden, and it is associated with the typical signs and symptoms of a localized arthritis. Although the temperature may be elevated, the general condition of the patient is good, even in the cases with a purulent articular exudate.

The prognosis is excellent, and recovery, with complete restoration of normal joint function, invariably occurs. The treatment consists in repeated aspiration of the involved joint.—*Henry Milch, M.D., New York, N. Y.*

LES NÉVRALGIES LOMBO-CRURALES D'ORGINE COLIQUE (Lumbocrural Neuralgias of Colic Origin). M. Brulé et H. Garban. *La Presse Médicale*, XLVII, 1061, July 5, 1939.

The writers recall the observations of other authors to the effect that lumbocrural pain has been observed in lesions of the caecum and colon. In cancer of the colon, in iliocaecal tuberculosis, in diverticulitis, in chronic constipation, in appendicitis, and in other lesions, whether of organic or functional nature, pain in the back or down the leg has been described.

This pain may be dull or sharp and lancinating. It is aggravated by walking or by

other sudden movements and is ameliorated by rest. It is made worse by cold and is relieved by heat. It is definitely associated with the colon and becomes more intense as the colonic lesion or dysfunction becomes more severe. Most commonly the clinical picture is that of a lumbago, situated low down, with pain located mainly in the gluteal region and along the anterior aspect of the thigh.

A number of tender points may be found in the lumbar region, in the gluteal region, in the thigh, at the knee, and at the medial malleolus. These points, some nine in number, exist at the sites of emergence of branches of the lumbar plexus, but never in the distribution of the sciatic nerve. Lasègue's sign is invariably negative. On the other hand, the opposite motion—hyperextension of the thigh on the trunk—frequently causes a marked accentuation of pain at the tender areas noted. The radiation of the pain is inconstant and may be down either one or both of the extremities.

The authors explain this relationship between the pain and the colonic disturbances on an anatomical basis. Both the ascending and the descending portions of the colon lie against the posterior abdominal wall where they cross the collateral branches of the lumbar plexus, especially the ilio-inguinal and the genitofemoral nerves. These nerves and the other collateral branches of the lumbar plexus are distributed to the same subperitoneal tissues in which the lymphatics which drain the intestinal wall course. The authors note that in such cases therapy of a local antalgic nature will be far less successful than measures directed toward relief of the underlying intestinal condition.—*Henry Milch, M.D., New York, N. Y.*

RADIATION THERAPY IN TUMOURS OF BONE. J. Struthers Fulton. *Proceedings of the Royal Society of Medicine*, XXXII, 473 (Sect. Radiol., 1), March 1939.

Radiation produces satisfactory results in symple cysts, chondromata, angiomata, and benign giant-cell tumors. Surgery is the method of choice in osteogenic sarcomata, except when non-operable growth may be restrained by roentgen-ray therapy. Direct invasion of bone by a tumor is not a contra-indication to roentgen-ray therapy. Ewing's tumor is usually accepted as radiosensitive, and diagnosis should be made before surgical attempts are advised, since surgical procedures usually result in dissemination of the lesion and in loss of the extremity later on. Metastases are reduced by roentgen-ray therapy, and in isolated cases the growth has disappeared. Pain is markedly relieved in a large number of cases.—*E. F. Thornton, M.D., Iowa City, Iowa.*

INJURIES TO BOTH SEMILUNAR CARTILAGES OF THE KNEE-JOINT. C. Lambrinudi. *Proceedings of the Royal Society of Medicine*, XXXII, 635 (Sect. Orthop., 15), March 1939.

The author reports eight cases of injury to both menisci of the knee joint. Six patients had pain on the inner side of the knee. In four cases the disability was attributed to quadriceps insufficiency and was treated as such for a long time. Four of the patients had a laxity of the ligament. Three received relief from the majority of their symptoms by removal of the lateral meniscus. The author concludes that dual lesions are fairly frequent and are often overlooked. The dislocation of the lateral meniscus is likely to be associated with strain of the cruciate ligaments rather than with loss of internal ligaments. — *E. F. Thornton, M.D., Iowa City, Iowa.*

THE BIOLOGY OF BONE METASTASES. Jonas Borak. (Translation by Franz J. Lust). *Radiology*, XXXIII, 208, Aug. 1939.

Skeletal metastases from malignant tumors are frequent. Malignancies of different organs vary greatly in their tendency to metastasize to bone, also in the skeletal regions in which metastasis takes place. Bone metastases occur in about 10 per cent. of all carcinomata.

The "ossophile" group of tumors includes those of organs having a glandular structure and a cylindrical epithelium such as, carcinomata of the prostate, thyroid, breast, and kidneys.

The "ossophobe" group is made up of squamous-celled epithelial tumors,—those originating in the skin, mouth, oesophagus, and portio uteri. In only about 1 per cent. of the cases does metastasis to bone take place.

The size of the primary tumor seems also to be a determining factor, small tumors being more often ossophile, and the primary tumor being discovered only after bone metastases have become manifest. "The frequency of bone metastases as compared to simultaneous visceral metastases varies with different types of carcinomas. It is, however, a fact that patients with lung metastases only occasionally show bone metastases and, *vice versa*, patients after having widespread metastases in the skeleton, are free from lung metastases for a long time."

Metastases are most frequent in the spine and then the pelvis, and are rare below the knee and elbow joints. They usually develop in the spongiosa; rarely in the cortex. Primary sarcomata, however, usually develop in the extremities. Malignant metastases invading the spine and pelvis tend to be osteoplastic, while the extremities and skull usually show osteolytic invasion.

In involvement of the extremities, pathological fracture is common, often going on to apparent spontaneous healing, which, however, is the result of stimulation of the metastatic lesion by trauma reaction to osteoplastic growth, the union being formed by osteoplastic carcinoma tissue. X-ray treatment may also set up an osteoplastic reaction, and may sometimes entirely destroy the metastases, with a "*restitutio ad integrum*". Metastases may be purely osteolytic, as in carcinoma of the kidney; osteolytic with shell formation (the cystic type of Kienböck or the "soap bubble" of Schintz), usually from thyroid carcinoma; purely osteoplastic ("marble bones"), frequently found in carcinoma of the prostate; osteoplastic with islands of increased density, usually from carcinoma of the breast; or of the mixed type (tiger-skin type), also usually from breast carcinoma.

Thus the metastases from prostate and breast are usually osteoplastic, most often involving the spine and pelvis, and are usually multiple and often generalized; while those of the kidneys and thyroid are usually osteolytic and solitary, and are relatively more frequent in the extremities. The latter are also much more prone to show simultaneous lung involvement, while in the former lung involvement occurs late if at all.—*Edward N. Reed, M.D., Santa Monica, California.*

FRACTURAS DEL FEMUR POR ARMA DE FUEGO (Gunshot Fractures of the Femur). R. Argüelles. *Revista Española de Medicina y Cirugía de Guerra, Sept. 1938.*

The author calls attention to the two conditions necessary for obtaining good results: (1) early surgical cleansing of the wound followed by effective fixation of the bone fragments; (2) rapid transportation of the injured person to a special hospital *where he remains until healing has taken place.* He uses, as standard treatment, Braun splints and skeletal traction with a Kirschner wire and from eight to ten kilograms of weight. Infection, if present, must be treated by wide incisions and the insertion of large rubber drains to control drainage. The operation should be done without removing the extension, the patient lying on his own bed with the leg in the splint.

The author has had under his care 252 cases of fracture of the femur: 55 per cent. of them were infected and 45 per cent. had an aseptic course. In 30.9 per cent. the fracture was in the upper third; in 37.3 per cent., in the middle third; and in 31.8 per cent., in the lower third. In ten cases there was sciatic-nerve palsy. Death occurred in twenty cases (7.9 per cent.). Amputation was necessary in thirteen cases (5.1 per cent.).—*Francisco P. Dueño, M.D., Madrid, Spain.*

LAS HERIDAS DE LA RODILLA POR ARMA DE FUEGO. SU TRATAMIENTO. (Gunshot Wounds of the Knee. Their Treatment.) R. Argüeilles. *Revista Española de Medicina y Cirugía de Guerra, March 1939.*

The treatment of infected war wounds of the knee joint requires perfect immobilization of the limb and thorough drainage of the exudate. To accomplish this, the author applies a plaster cast, extending from the hip to the foot with a window over the knee.

In simple cases, with punctiform rifle-bullet wounds, symptoms disappear quickly. In cases of severe arthritis, after applying the cast, the author practises bilateral anterior arthrotomy, followed by the insertion of large drainage tubes. Afterwards, the wound is given open-air treatment. According to the author's experience, it is not necessary to employ posterior incisions.

Of a series of forty-three patients, eleven with clean joint wounds were cured, with joint mobility between 20 degrees and normal; in the other thirty-two with suppurative arthritis, healing occurred without mobility.—*Francisco P. Dueño, M.D., Madrid, Spain.*

CONTRIBUCIÓN AL ESTUDIO DEL SINDROME DE VOLKMANN (Contribution to the Study of Volkmann's Paralysis). F. E. Godoy Moreira. *Revista de Ortopedia y Traumatología*, VIII, 329, 1939.

The author considers this lesion to be the result of myositis of the affected limb, due to impairment of circulation. Pathological studies have shown sclerotic degeneration of the muscles at various stages. The alteration of the nerves is neither typical nor constant. It seems that the most constant lesion is the alteration of the blood vessels, which have often been found to be obliterated by an inflammatory process. The majority of cases have been seen in children, but this may be due to the fact that less heed is paid to the complaints of children than to those of adults.

There is probably a congenital factor, as demonstrated by the fact that sometimes minimal causes, such as the application of an Esmarch bandage, suffice to produce this paralysis. Ordinarily this lesion is caused by the too tight application of a plaster cast or splint to a limb. Cases of Volkmann's paralysis are on record which have appeared after simple contusion of a limb. The exact mechanism of production of this lesion is still a matter of controversy. Lorenz ascribes this paralysis to thrombosis of the humeral artery. Bardenheuer is of the opinion that the humeral artery is enclosed as a consequence of lesions of its inner sheath. Wallis had opportunity to observe a case which developed after the application of an Esmarch bandage, in which there was a lesion of the internal sheath of the humeral artery, with formation of a large clot and obstruction of the lumen of the blood vessel. The author had opportunity to dissect a forearm which had to be amputated because of infection in a limb with Volkmann's paralysis that had been treated elsewhere by too tight application of wooden splints. The dissection showed obstruction of the humeral vessel by a clot just above its bifurcation. The muscles appeared to be ischaemic, and the nerves of the forearm showed no alteration.

The author reports four cases of Volkmann's paralysis of different degrees of severity. Three of these were treated by shortening the bones of the forearm, and one was treated by gradual stretching of the retracted tendons. The results in these cases were uniformly good. The author calls attention to the fact that in his first case, that of a young man of sixteen, this lesion was of ten years' duration.—*Hugo Enriquez, M.D., Iowa City, Iowa.*

NECROSIS ASEPTICA DE LA CABEZA HUMERAL CONSECUTIVA A LUXACIÓN DE HOMBRO Y FRACTURA DEL CUELLO DEL HUMERO (Aseptic Necrosis of the Head of the Humerus Following Dislocation of the Shoulder and Fracture of the Neck of the Humerus). Enrique H. Lagomarsino y Domingo T. Muscolo. *Revista de Ortopedia y Traumatología*, IX, 253, 1939.

The author reports a case of luxation of the upper end of the humerus with comminuted fracture of the surgical neck, which was treated by open reduction. Ninety days after the operation, examination showed delayed union and aseptic necrosis of the head of the humerus. The author calls attention to the rarity of this necrosis as compared to the similar necrosis which develops on the head of the femur, the carpal bones, and the bones of the foot. He is of the opinion that the cause of the lesion in question is the same as that which brings about the necrosis of the head of the femur,—namely, insufficient blood supply by intervention of the trauma. A study of the circulation of the head of the humerus is presented, and the author points out the fact that, although

there is an ample blood supply to this part of the human skeleton during infancy and adolescence, the circulation diminishes considerably during adult life.—*Hugo Enriquez, M.D.*, Iowa City, Iowa.

A PROPOS DES SUPPURATIONS OSSEUSES MÉTASTATIQUES À STAPHYLOCOQUES AU COURS DE L'ÉVOLUTION DES FURONCLES ET DES ANTHRAX CHEZ L'ADULTE (Concerning the Staphylococcic Metastatic Bone Suppurations in the Course of Development of Furuncles and Carbuncles in the Adult). R. Peycelon. *Revue d'Orthopédie et de Chirurgie de l'Appareil Moteur*, XXVI, 33, 1939.

The true primary acute infections of bone are relatively rare in the adult. The majority of these infections are of a metastatic nature. This type of infection has been described by several observers. It has been found that most of these bone infections follow some staphylococcic involvement of the soft parts. They have a characteristic anatomical localization, involving mostly the long bones and forming suppurative foci in the mid-diaphyseal portion of the bone. This is in contrast to the adolescent type, where the foci form in the metaphyseal regions. The formation of the foci in the region of the diaphysis, apparently in connection with the nutrient canal of the bone, speaks for the metastatic nature of this affliction. Three types of cases are usually observed: (1) the acute osteomyelitic form, involving all the layers of the bone and having a course similar to the acute adolescent type; (2) the subacute cortical variety, involving only the cortex and having a more protracted evolution, with secondary periostitis simulating the roentgenographic appearance of syphilis of bone or sarcoma; (3) the most superficially localized type, metastatic periostitis. The author reports six cases of this last type. The most important characteristic of this lesion is its superficiality, the periosteum only being involved. The course of this affliction is comparatively mild. In the author's series the pelvis was found to be involved in two cases. The treatment is incision and drainage. The postoperative course is comparatively short and uncomplicated. Although the author could not state whether or not the subsequent stages would follow the usual course of osteomyelitis, he considers this type as the most benign.—*Emanuel Kaplan, M.D., New York, N. Y.*

LE RHUMATISME FIBREUX. SES DIVERSES FORMES. Mathieu-Pierre Weil, Raphaël Massart, et Mlle. N. Lititchewsky. *Revue du Rhumatisme*, VI, March 1939.

Fibrous rheumatism or fibrositis is the most common form of rheumatism. It has a peculiar predilection for the aged. It is occasionally infectious, but more commonly it is the result of hepatic or intestinal disturbances. Occasionally it may be traumatic. The chief signs are muscular pain and inability to move the part. The temperature, the sedimentation rate of the blood, and the roentgenographic appearance are normal. Three forms are recognized: (1) fibrositis, an inflammation of the large aponeuroses and fascial planes; (2) tendinitis, which most frequently follows trauma; and (3) disease of the insertions, which frequently follows sports. In the late stages there may be calcification. In treatment, heat is most important. Infiltration with cocaine (novocain) solutions is advocated. Mobilization of the involved muscle is essential.—*John G. Kuhns, M.D., Boston, Massachusetts.*

THE PHOSPHATASE DETERMINATION IN THE DIFFERENTIAL DIAGNOSIS OF BONE LESIONS. C. C. Franseen, C. C. Simmons, and Regina McLean. *Surgery, Gynecology and Obstetrics*, LXVIII, 1038, June 1939.

Additional evidence to the effect that the increased phosphatase activity of the blood in patients with bone lesions is the product of the intracellular activity of the osteoblasts is presented by the authors. The level of the phosphatase activity found in the blood in the presence of a bone lesion corresponds closely to the theoretical expected level determined by a study of the gross and microscopic evidence of the osteoblastic activity in the lesion.

That the phosphatase determination is often useful in the differential diagnosis of bone lesions is discussed in a review of the chemical analysis of several bone-forming and bone-destroying lesions. The relationship of this phosphatase activity of the blood to calcium, phosphorus, and serum-protein values found in various bone lesions is considered.—*A. I. Blieden, M.D., Iowa City, Iowa.*

UNTERSUCHUNGEN ÜBER DAUERRESULTE NACH DER UNBLUTIGEN REPOSITION DER ANGEBORENEN HÜFTVERRENKUNG (Investigations of the Permanent Results after Bloodless Reduction of Congenital Dislocation of the Hip). H. Gickler und J. Meurer. *Zeitschrift für Orthopädische Chirurgie*, LXVII, 235, 1937–1938.

Eighty-five cases from Hackenbroch's Clinic, with the late end results, are reported. These are especially interesting because no attempt has been made to cover up any untoward effect of the treatment. Only cases with a five-year observation period are included.

The number of recurrent dislocations and subluxations is very high,—sixty-six or 77.6 per cent. The explanation of this rather high percentage of recurrent dislocation is that the authors are very severe in their definition of recurrent dislocation, and their requirements for what is called "anatomical cure" are most exacting. In all the cases of recurrent subluxation there is a more or less pronounced disturbance in the development of the acetabulum and incongruity between head and socket. There are also many patients who show a certain restriction in motion, particularly in abduction. Such restriction was found in 67 per cent. of the cases, while limitation of flexion was found in 13 per cent.—*Arthur Steindler, M.D., Iowa City, Iowa.*

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Archivos Médicos Ferrocarrileros (México, D. F.), I, No. 2, 1939.

Boletín de la Sociedad de Cirugía de Montevideo, IX, Nos. 10–12, 1938; X, No. 1, 1939.

Boletines de la Sociedad de Cirugía de Rosario, VI, Nos. 1, 3, 4, 1939.

Bollettino e Atti della Reale Accademia Medica di Roma, LXIV, Fasc. 10–12, 1938; LXV, Fasc. 1–3, 1939.

The Child (Washington, D. C.), III, Nos. 11 and 12, and Supplement No. 4 (Social Statistics), 1939; IV, Nos. 1–3, 1939.

Current Medicine (Los Angeles), VI, No. 9, 1939.

Gaceta Peruana de Cirugía y Medicina (Lima), II, Nos. 16 and 17, 1939.

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Myelogenous Leukemia. William G. Doern, M.S., M.D. Milwaukee, 1939.

Radiography and Clinical Photography (Rochester, N. Y.), XV, No. 2, 1939.

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Roche Review (Nutley, N. J.), III, No. 11, 1939.

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The Rockefeller Foundation. International Health Division. Annual Report, 1938. New York, 1939.

The Tohoku Journal of Experimental Medicine, XXXVI, Nos. 1–3, 1939.

La Tribuna Médica (Habana), XIII, No. 253, 1939.

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Villaclara Médica (Santa Clara, Cuba), VII, Núm. 3, 1939.

INDEX TO VOLUME XXI

1939

OLD SERIES VOLUME XXXVII

AUTHORS

A PAGE

Aitken, Alexander P.; Blackett, Charles W.; and **Cincotti, John J.** Overgrowth of the Femoral Shaft Following Fracture in Childhood 334
Allen, Lyman, and **Ferguson, John A.** Complete Medial Dislocation of the Knee Joint with Division of the Common Peroneal Nerve 1012
Arkin, Alvin M. Movable Traction Carrier. An Apparatus for Combining Traction with Motion at the Hip 1032
Atsatt, Rodney F. Acute Osteomyelitis of a Vertebral Body Following Compression Fracture 346

B

Bartels, William P. The Treatment of Intertrochanteric Fractures 773
Bartels, William P., and **Hudson, Otho C.** Open Fixation of Intracapsular Fracture of the Femur. An Improved Technique 1001
Batts, Martin, Jr. The Etiology of Spondylolisthesis 879
Rupture of the Nucleus Pulposus. An Anatomical Study 121
Bernheim, Alice R.; Person, E. Cooper; and **Cornell, Nelson W.** The Use of Hydrochloric Acid in Certain Cases of Atrophy and Delayed Calcification in Fractured Bones 40
Bishop, W. A., Jr. Vertebral Lesions in Undulant Fever 665
Blackett, Charles W.; Cincotti, John J.; and **Aitken, Alexander P.** Overgrowth of the Femoral Shaft Following Fracture in Childhood 334
Boyd, H. B. Amputation of the Foot, with Calcaneotibial Arthrodesis 997
Brailsford, James F. Osteochondritis of the Adult Tarsal Navicular 111
Branch, Hira E. Drop-Foot. End Results of a Series of Bone-Block Operations 141
Brennecke, Frances, and **Hodgen, John T.** Osteochondroma of the Fibula with Resultant Foot Drop 405
Brockway, Alvia. An Operation to Improve Abduction Power of the Shoulder in Poliomyelitis 451
Burman, Michael S., and **Sutro, Charles J.** Recurrent Luxation of the Ulnar Nerve by Congenital Posterior Position of the Medial Epicondyle of the Humerus 958

C

Calvé, Jacques; Galland, Marcel; and **de Cagny, Roger.** Pathogenesis of the Limp Due to Coxalgia. The Antalgic Gait 12
Campbell, Willis C. The Autogenous Bone Graft 694
Carpenter, Alvin R. Tendon Transplantation. An End-Result Study of 458 Transplantations 921
Cave, Edwin French. Kienböck's Disease of the Lunate 858
Chaklin, V. D. Injuries to the Cartilages of the Patella and the Femoral Condyle 133
Christophe, Kenneth. A Functioning False Shoulder Joint Following an Old Dislocation 916
Cincotti, John J.; Aitken, Alexander P.; and **Blackett, Charles W.** Overgrowth of the Femoral Shaft Following Fracture in Childhood 334
Cleveland, Mather. Surgical Treatment of Joint Tuberculosis 607
Colonna, Paul C. The Colonna Reconstruction Operation for Ununited Fractures of the Neck of the Femur. Analysis of Seventy Cases 701
Compere, Edward L., and **Nichols, Russell L.** The Use of Insulin as an Adjunct in the Treatment of Bone and Joint Tuberculosis 885
Conwell, H. Earle, and **Smith-Petersen, M N.** Treatment of Fractures of the Neck of the Femur by Internal Fixation. Report of the Fracture Committee of the American Academy of Orthopaedic Surgeons 483
Cooper, William; Steindler, A.; and **Hamsa, William R.** The Compensation-Derotation Treatment of Scoliosis 51
Cornell, Nelson W.; Bernheim, Alice R.; and **Person, E. Cooper.** The Use of Hydrochloric Acid in Certain Cases of Atrophy and Delayed Calcification in Fractured Bones 40

PAGE

Cox, Wilbur J. A New Electric Power Unit for Drilling and Sawing Bone..... 1048
Crego, C. H., Jr. The Use of Skeletal Traction as a Preliminary Procedure in the Treatment of Early Congenital Dislocation of the Hip..... 353
Crego, C. H., Jr., and McCarroll, H. R. Primary Anterior Congenital Dislocation of the Hip..... 648
Curry, G. J. Fractures of the Pelvis. Management by Use of a Posterior Plaster-of-Paris Shell..... 384
Curtis, George M., and Klassen, Karl P. The Calcium and Phosphorus Metabolism in Ossifying Fibroma of the Mandible..... 444

D

Davidson, Arthur J., and Horwitz, M. Thomas. Congenital Club-Hand Deformity Associated with Absence of Radius: Its Surgical Correction. A Case Report. 462
de Cagny, Roger; Calvé, Jacques; and Galland, Marcel. Pathogenesis of the Limp Due to Coxalgia. The Antalgic Gait..... 12
De Santo, Dominic A., and Wilson, Philip D. Xanthomatous Tumors of Joints.. 531
Dial, Donald E. Reconstruction of Thumb after Traumatic Amputation..... 98
Dobelle, Martin. An Unusual Location of an Osteochondroma. Report of a Case..... 781
Downing, F. Harold. The Recurrence of Flexion and Adduction Deformities Following Operative Fusion of the Hip and Subtrochanteric Osteotomy.... 909
Dueño, Francisco P. Direct Leverage in the Treatment of Gunshot Fractures of the Forearm..... 373
Dunlop, John. Transcondylar Fractures of the Humerus in Childhood..... 59

E

Edelstein, J. M. Treatment of Ununited Fractures of the Carpal Navicular.... 902

F

Farkas, Aladár. A New Operative Treatment of Tuberculous Coxitis in Children. 323
Fell, Egbert H., and Speed, Kellogg. Temperature-Controlled Healing of Experimental Fractures..... 1005
Ferciot, C. Fred. A Simplified Directional Guide for Hip Nailing..... 1023
Ferguson, A. B.; Thompson, F. R.; and King, B. B. A Two-Stage Osteotomy... 715
Ferguson, John A., and Allen, Lyman. Complete Medial Dislocation of the Knee Joint with Division of the Common Peroneal Nerve..... 1012
Fischer, Walter R. Fracture of the Scapula Requiring Open Reduction. Report of a Case..... 459

G

Galland, Marcel; de Cagny, Roger; and Calvé, Jacques. Pathogenesis of the Limp Due to Coxalgia. The Antalgic Gait..... 12
Garber, J. Neill. Volkmann's Contracture as a Complication of Fractures of the Forearm and Elbow..... 154
Garden, Robert S. Ossification in the Anterior Cruciate Ligament..... 1027
Geist, Donald C. Dislocation of the Hamate Bone. Report of a Case..... 215
Geschickter, Charles F., and Maseritz, I. H. Affections of Muscles..... 576
Ewing's Sarcoma..... 26
Skeletal Metastasis in Cancer... 314
Ghormley, Ralph K., and Valls, Jorge E. Metastasis to Bone from Carcinoma of the Gastro-Intestinal Tract..... 74
Gill, A. Bruce. Arthrodesis for Ununited Fracture of the Neck of the Femur.... 710
Goldenberg, Raphael R. Elastic Straps to Prevent Slipping of a Knee Cage.... 797
Gradoyevitch, Borivoye. Coracoclavicular Joint..... 918
Greenberg, Lewis. Dupuytren's Contracture of Palmar and Plantar Fasciae.... 785

H

Haas, S. L. Experimental Production of Scoliosis..... 963
Hagen, Walter H. Coxa Plana. Report of Two Bilateral Cases in Brothers.... 1028
Haines, Charles. Compound Dislocation of the Tibiotalar Joint without Fracture and without Separation..... 205
Hamsa, William R.; Cooper, William; and Steindler, A. The Compensation-Derotation Treatment of Scoliosis..... 51
Hawley, George W. Arm Control for Operations on the Upper Extremity on the Hawley Table..... 794
Herzmark, Maurice H. Fracture of an Articular Process..... 1031
Heyman, Clarence H. Posterior Fasciotomy in the Treatment of Back Pain.... 397

PAGE

Hill, Robert B. Habitual Dislocation of the Distal End of the Ulna. Report of a Case . . . 780
Hinton, Drury. Supracondylar Fracture of the Femur with Anterior Position of the Lower Fragment . . . 719
Hipps, Herbert E. Fissure Formation in Articular Facets of the Lumbar Spine. Operative Findings in One Case . . . 289
Hodgen, John T., and Brennecke, Frances. Osteochondroma of the Fibula with Resultant Foot Drop . . . 405
Hodges, Frank C. Tuberculosis of the Long Bones. A Report of Six Cases. . . . 148
Horwitz, M. Thomas, and Davidson, Arthur J. Congenital Club-Hand Deformity Associated with Absence of Radius: Its Surgical Correction. A Case Report . . . 462
Hudson, Otho C., and Bartels, William P. Open Fixation of Intracapsular Fracture of the Femur. An Improved Technique . . . 1001

J

Jacobson, Edwin W.; Wilson, Milton J.; and Michele, Arthur A. Ankle Dislocations without Fracture . . . 198
Isolated Fracture of the Lesser Trochanter . . . 776
Jewett, Eugene L. A Case of Freiberg's Disease Treated by a Walking Cast . . . 778
A Method for Treating Displaced Fractures of the Pelvis . . . 177

K

Kazanjian, V. H. Congenital Absence of the Ramus of the Mandible . . . 761
Key, J. Albert.; Rosenfeld, Herman; and Tjoflat, O. E. Gold Therapy in Proliferative (Especially Atrophic) Arthritis . . . 339
King, Byron B. Resection of the Radial Head and Neck. An End-Result Study of Thirteen Cases . . . 839
King, B. B.; Ferguson, A. B.; and Thompson, F. R. A Two-Stage Osteotomy. . . . 715
Kite, J. H. Principles Involved in the Treatment of Congenital Club-Foot . . . 595
Klassen, Karl P., and Curtis, George M. The Calcium and Phosphorus Metabolism in Ossifying Fibroma of the Mandible . . . 444
Kleinberg, Samuel. Malignant Giant-Cell Tumor of Bone. Report of a Case Involving the Tibia . . . 433
Kling, David H.; Sashin, David; and Spanbock, Joseph. Gold Therapy in Rheumatoid Arthritis . . . 723
Kuth, Joseph R. Isolated Dislocation of the Carpal Navicular. A Case Report . . . 479

L

Lamy, L., and Weissman, L. Congenital Convex Pes Valgus . . . 79
Lapidus, Paul W. Congenital Bilateral Talipes Equinus in Twins . . . 792
Congenital Unilateral Absence of the Medial Sesamoid of the Great Toe. Report of a Case . . . 208
Operation for Correction of Hammer-Toe . . . 977
LeMesurier, A. B. The Methods Used in Handling the Epidemic of Poliomyelitis in Ontario in 1937 . . . 867
L'Episcopo, Joseph B., and Sabatelle, Peter E. The Hoke Operation for Flat Feet . . . 92
Levinthal, Daniel H., and Wolin, Irving. Unilateral Congenital Elevation of the Ilium or Congenital Dislocation of the Sacro-Iliac Joint. A Rare Anomaly . . . 193
Lippmann, Robert K. Experiences with the Corkscrew Bolt . . . 735

M

McCarroll, H. R., and Crego, C. H., Jr. Primary Anterior Congenital Dislocation of the Hip . . . 648
McDonald, J. E., and Stuart, Frank A. Stenosing Tendovaginitis at the Radial Styloid Process . . . 1035
McMurray, T. P. Osteo-Arthritis of the Hip Joint . . . 1
Macey, Harry B. A New Instrument for Passing the Parham Band . . . 1047
Maddox, Robert D. An Invalid-Lifting Apparatus . . . 470
Maseritz, I. H., and Geschickter, Charles F. Affections of Muscles . . . 576
Ewing's Sarcoma . . . 26
Skeletal Metastasis in Cancer . . . 314
Mayer, Leo. Operative Reconstruction of the Paralyzed Upper Extremity . . . 377
Melville, R. Saunders. Utilization of the Body Weight in Treatment of the Residual Deformity in Club Feet . . . 456
Mercer, Walter. A New Knife for the Removal of the Meniscus . . . 474
Meyers, Maurice P., and Schmier, Adolph A. Bilateral Osteochondritis of the Pisiform. Report of a Case . . . 789

PAGE

Michele, Arthur A.; Jacobson, Edwin W.; and **Wilson, Milton J.** Ankle Dislocations without Fracture ... 198
Isolated Fracture of the Lesser Trochanter ... 776
Milch, Henry. Internal-Rotation-Brace Treatment of Epiphyseal Coxa Anteverta (Early Epiphysiolysis) ... 752
Synostosis Operation for Persistent Non-Union of the Tibia. A Case Report ... 409
Miller, O. L. Blind Nailing of the T Fracture of the Lower End of the Humerus Which Involves the Joint ... 933
Mortensen, O. A.; Sullivan, W. E.; and **Norton, W. I.** Morphological Changes Accompanying Fixation of the Biceps Tendon (Nicola Operation). An Experimental Study on Animals ... 127
Murphy, Frank G. Osteochondritis Dissecans of the Elbow Joint ... 464

N

Nichols, Russell L., and **Compere, Edward L.** The Use of Insulin as an Adjunct in the Treatment of Bone and Joint Tuberculosis ... 885
Norton, W. I.; Mortensen, O. A.; and **Sullivan, W. E.** Morphological Changes Accompanying Fixation of the Biceps Tendon (Nicola Operation). An Experimental Study on Animals ... 127

O

Obletz, Ben E., and **Potts, Frank N.** Aseptic Necrosis of Head of Femur Following Traumatic Dislocation ... 101
Olson, Paul F. The Treatment of Fractures of the Os Calcis ... 747

P

Padula, Ralph D. An Attachment to the Hawley Table for the Treatment of Fractures of the Lumbar, Thoracic, and Cervical Spine ... 1036
Palmer, Ivar. Compression Fractures of the Lateral Tibial Condyle and Their Treatment ... 674
Pavlík, Arnold. Treatment of Obstetrical Fractures of the Femur ... 939
Person, E. Cooper; Cornell, Nelson W.; and **Bernheim, Alice R.** The Use of Hydrochloric Acid in Certain Cases of Atrophy and Delayed Calcification in Fractured Bones ... 40
Peterson, Leonard T., and **Sloat, J. I.** A New Device for Facilitating the Taking of Roentgenograms When Performing the Extra-Articular Method of Internal Fixation in Fractures of the Femoral Neck ... 1041
Phemister, Dallas B. The Pathology of Ununited Fractures of the Neck of the Femur with Special Reference to the Head ... 681
Pohl, John F. Chondro-Osteodystrophy (Morquio's Disease). Progressive Kyphosis from Congenital Wedge-Shaped Vertebrae ... 187
Potts, Frank N., and **Obletz, Ben E.** Aseptic Necrosis of Head of Femur Following Traumatic Dislocation ... 101
Pulvertaft, R. Guy. Nephrolithiasis Occurring in Recumbency ... 559
Putnam, Tracy J. The Diagnosis and Treatment of Athetosis and Dystonia ... 948

R

Rankin, John O. Adamantinoma of the Tibia ... 425
Roberts, Sumner M., and **Vogt, Edward C.** Pseudofracture of the Tibia ... 891
Robertson, H. E., and **Shoemaker, Rosemary.** Osteosarcoma of the Bony Pelvis Associated with Carcinoma of the Urinary Bladder ... 169
Rogers, S. Perry. Avulsion of Tendon of Attachment of Biceps Brachii. A Case Report ... 197
Rosenfeld, Herman; Tjoflat, O. E.; and **Key, J. Albert.** Gold Therapy in Proliferative (Especially Atrophic) Arthritis ... 339
Rothberg, Abraham S. Avulsion Fracture of the Os Calcis ... 218
Fractures of the Carpal Navicular. Importance of Special Roentgenography ... 1020
Rush, H. Lowry, and **Rush, Leslie V.** Avulsion of the Anterior Superior Spine of the Ilium. A Case Report ... 206
A Technique for Longitudinal Pin Fixation of Certain Fractures of the Ulna and of the Femur ... 619
Rush, Leslie V., and **Rush, H. Lowry.** Avulsion of the Anterior Superior Spine of the Ilium. A Case Report ... 206

PAGE

Rush, Leslie V., and **Rush, H. Lowry.** A Technique for Longitudinal Pin Fixation of Certain Fractures of the Ulna and of the Femur 619

S

Sabatelle, Peter E., and **L'Episcopo, Joseph B.** The Hoke Operation for Flat Feet. 92
Sashin, David; Spanbock, Joseph; and **Kling, David H.** Gold Therapy in Rheumatoid Arthritis 723
Schmier, Adolph A. A Muscle Tester for Poliomyelitis Cases. Attachment for a Permanent Record 475
Schmier, Adolph A., and **Meyers, Maurice P.** Bilateral Osteochondritis of the Pisiform. Report of a Case 789
Selig, Seth. Objections to the Use of Kirschner Wire for Fixation of Femoral-Neck Fractures 182
Severin, Erik. Arthrography in Congenital Dislocation of the Hip 304
Shehadi, William H. Primary Pyogenic Osteomyelitis of the Articular Processes of the Vertebrae. Report of an Unusual Case 969
Shoemaker, Rosemary, and **Robertson, H. E.** Osteosarcoma of the Bony Pelvis Associated with Carcinoma of the Urinary Bladder 169
Sideman, Sidney. A Simple Leg Elevator Incorporated in a Plaster Cast. 1045
Simon, Harold E., and **Williamson, Byrn.** Epiphysitis of the Os Calcis 1015
Sloat, J. I., and **Peterson, Leonard T.** A New Device for Facilitating the Taking of Roentgenograms When Performing the Extra-Articular Method of Internal Fixation in Fractures of the Femoral Neck 1041
Smith-Petersen, M. N. Arthroplasty of the Hip. A New Method 269
Smith-Petersen, M. N., and **Conwell, H. Earle.** Treatment of Fractures of the Neck of the Femur by Internal Fixation. Report of the Fracture Committee of the American Academy of Orthopaedic Surgeons 483
Somers, Donald C. Generalized Myositis Fibrosa. Report of a Case 414
Spanbock, Joseph; Kling, David H.; and **Sashin, David.** Gold Therapy in Rheumatoid Arthritis 723
Speed, Kellogg, and **Fell, Egbert H.** Temperature-Controlled Healing of Experimental Fractures 1005
Stein, Justin J. Bone Metastasis from Primary Carcinoma of the Lung. Report of an Unusual Case 992
Steindler, A.; Hamsa, William R.; and **Cooper, William.** The Compensation-Derotation Treatment of Scoliosis 51
Stuart, Frank A., and **McDonald, J. E.** Stenosing Tendovaginitis at the Radial Styloid Process 1035
Sullivan, W. E.; Norton, W. I.; and **Mortensen, O. A.** Morphological Changes Accompanying Fixation of the Biceps Tendon (Nicola Operation). An Experimental Study on Animals 127
Sutro, Charles J., and **Burman, Michael S.** Recurrent Luxation of the Ulnar Nerve by Congenital Posterior Position of the Medial Epicondyle of the Humerus 958
Swaim, Loring T. The Orthopaedic Treatment of Strümpell-Marie Arthritis 983

T

Taylor, K. P. A., and **Voshell, Allen F.** Regeneration of the Lateral Condyle of the Humerus after Excision 421
Thompson, F. R.; King, B. B.; and **Ferguson, A. B.** A Two-Stage Osteotomy ... 715
Thompson, T. Campbell. Astragalectomy and the Treatment of Calcaneovalgus. 627
Tjoflat, O. E.; Key, J. Albert; and **Rosenfeld, Herman.** Gold Therapy in Proliferative (Especially Atrophic) Arthritis 339

V

Valls, Jorge E., and **Ghormley, Ralph K.** Metastasis to Bone from Carcinoma of the Gastro-Intestinal Tract 74
Virgin, Herbert W., Jr. A Serviceable Goniometer with Supination-Pronation Attachment 221
Vogt, Edward C., and **Roberts, Sumner M.** Pseudofracture of the Tibia 893
vom Saal, Frederick. Epiphysiodesis Combined with Amputation 442
Voshell, Allen F., and **Taylor, K. P. A.** Regeneration of the Lateral Condyle of the Humerus after Excision 421

W

Weissman, L., and **Lamy, L.** Congenital Convex Pes Valgus 79
Wheeldon, Thomas. A Sleeved-Wire Method of Fixation of Fractures 210
The Use of Cellophane as a Permanent Tendon Sheath.... 393

PAGE

Whitman, Royal. The Whitman Reconstruction Operation 1051
Wilkinson, F. R. Rapid Roentgenography in the Operating Room, with a Single Solution 387
Williamson, Byrn, and **Simon, Harold E.** Epiphysitis of the Os Calcis 1015
Wilson, Milton J.; Michele, Arthur A.; and **Jacobson, Edwin W.** Ankle Dislocations without Fracture 198
Isolated Fracture of the Lesser Trochanter 776
Wilson, Philip D., and **De Santo, Dominic A.** Xanthomatous Tumors of Joints . . 531
Wise, Robert A. An Unusual Fracture of the Terminal Phalanx of the Finger . . . 467
Wolf, Josef. An Appliance for the Prevention of Recurrent Dislocation of the Shoulder 472
Wolin, Irving, and **Levinthal, Daniel H.** Unilateral Congenital Elevation of the Ilium or Congenital Dislocation of the Sacro-Iliac Joint. A Rare Anomaly . 193

SUBJECT INDEX

A

Abduction Power of the Shoulder in Poliomyelitis, An Operation to Improve. Alvia Brockway 451
Absence, Congenital, of the Ramus of the Mandible. V. H. Kazanjian 761
Absence, Congenital Unilateral, of the Medial Sesamoid of the Great Toe. Report of a Case. Paul W. Lapidus 208
Absence of Radius, Congenital Club-Hand Deformity Associated with: Its Surgical Correction. A Case Report. Arthur J. Davidson and M. Thomas Horwitz . 462
Academy of Physical Medicine 226
Acid, Hydrochloric, The Use of, in Certain Cases of Atrophy and Delayed Calcification in Fractured Bones. Nelson W. Cornell, Alice R. Bernheim, and E. Cooper Person 40
Acute Osteomyelitis of a Vertebral Body Following Compression Fracture. Rodney F. Atsatt 346
Adamantinoma of the Tibia. John O. Rankin 425
Adduction Deformities, The Recurrence of Flexion and, Following Operative Fusion of the Hip and Subtrochanteric Osteotomy. F. Harold Downing 909
Affections of Muscles. Charles F. Geschickter and I. H. Maseritz 576
American Academy of Orthopaedic Surgeons 228, 483, 1055
American Association of Industrial Physicians and Surgeons 490
American Board of Orthopaedic Surgery 488, 804, 1055
American Conference on Occupational Diseases and Industrial Hygiene 490
American Orthopaedic Association 488, 802
American Physicians' Art Association 490
American Public Health Association 489, 1055
American Society for the Study of Arthritis 806
Amputation, Epiphysiodesis Combined with. Frederick vom Saal 442
Amputation of the Foot, with Calcaneotibial Arthrodesis. H. B. Boyd 997
Amputation, Traumatic, Reconstruction of Thumb after. Donald E. Dial 98
[Ankle]. Compound Dislocation of the Tibiotalar Joint without Fracture and without Separation. Charles Haines 205
Ankle Dislocations without Fracture. Milton J. Wilson, Arthur A. Michele, and Edwin W. Jacobson 198
Antalgic Gait, The. Pathogenesis of the Limp Due to Coxalgia. Jacques Calvé, Marcel Galland, and Roger de Cagny 12
Anterior Congenital Dislocation, Primary, of the Hip. H. R. McCarroll and C. H. Crego, Jr. 648
Anterior Cruciate Ligament, Ossification in the. Robert S. Garden 1027

PAGE

Apparatus
Appliance for the Prevention of Recurrent Dislocation of the Shoulder, An. Josef Wolf . . . 472
Arm Control for Operations on the Upper Extremity on the Hawley Table. George W. Hawley . . . 794
Attachment to the Hawley Table for the Treatment of Fractures of the Lumbar, Thoracic, and Cervical Spine, An. Ralph D. Padula . . . 1036
Elastic Straps to Prevent Slipping of a Knee Cage. Raphael R. Goldenberg. 797
Invalid-Lifting Apparatus, An. Robert D. Maddox . . . 470
Movable Traction Carrier. An Apparatus for Combining Traction with Motion at the Hip. Alvin M. Arkin . . . 1032
Muscle Tester for Poliomyelitis Cases, A. Attachment for Permanent Record. Adolph A. Schmier . . . 475
New Device for Facilitating the Taking of Roentgenograms When Performing the Extra-Articular Method of Internal Fixation in Fractures of the Femoral Neck, A. J. I. Sloat and Leonard T. Peterson . . . 1041
New Electric Power Unit for Drilling and Sawing Bone, A. Wilbur J. Cox . . 1048
New Instrument for Passing the Parham Band, A. Harry B. Macey . . . 1047
New Knife for the Removal of the Meniscus, A. Walter Mercer . . . 474
Serviceable Goniometer with Supination-Pronation Attachment, A. Herbert W. Virgin, Jr. . . . 221
Simple Leg Elevator Incorporated in a Plaster Cast, A. Sidney Sideman . . . 1045
Simplified Directional Guide for Hip Nailing, A. C. Fred Ferciot . . . 1023
Sleeved-Wire Method of Fixation of Fractures, A. Thomas Wheeldon . . . 210
Apparatus, An Invalid-Lifting. Robert D. Maddox . . . 470
Appliance for the Prevention of Recurrent Dislocation of the Shoulder, An. Josef Wolf . . . 472
Arm Control for Operations on the Upper Extremity on the Hawley Table. George W. Hawley . . . 794
[**Arthritis,** Atrophic.] Gold Therapy in Proliferative (Especially Atrophic) Arthritis. J. Albert Key, Herman Rosenfeld, and O. E. Tjoflat . . . 339
Arthritis, Osteo-, of the Hip Joint. T. P. McMurray . . . 1
Arthritis, Proliferative (Especially Atrophic), Gold Therapy in. J. Albert Key, Herman Rosenfeld, and O. E. Tjoflat . . . 339
Arthritis, Rheumatoid, Gold Therapy in. David Sashin, Joseph Spanbock, and David H. Kling . . . 723
Arthritis, Strümpell-Marie, The Orthopaedic Treatment of. Loring T. Swaim . . . 983
Arthrodesis, Calcaneotibial, Amputation of the Foot, with. H. B. Boyd . . . 997
Arthrodesis for Ununited Fracture of the Neck of the Femur. A. Bruce Gill . . . 710
Arthrography in Congenital Dislocation of the Hip. Erik Severin . . . 304
Arthroplasty of the Hip. A New Method. M. N. Smith-Petersen . . . 269
Arthur Thornton Legg . . . 1054
Articular Facets of the Lumbar Spine, Fissure Formation in. Operative Findings in One Case. Herbert E. Hipps . . . 289
Articular Process, Fracture of an. Maurice H. Herzmark . . . 1031
Articular Processes of the Vertebrae, Primary Pyogenic Osteomyelitis of the. Report of an Unusual Case. William H. Shehadi . . . 969
Aseptic Necrosis of Head of Femur Following Traumatic Dislocation. Frank N. Potts and Ben E. Obletz . . . 101
Astragalectomy and the Treatment of Calcaneovalgus. T. Campbell Thompson. 627
Athetosis and Dystonia, The Diagnosis and Treatment of. Tracy J. Putnam . . . 948
[**Atrophic Arthritis.**] Gold Therapy in Proliferative (Especially Atrophic) Arthritis. J. Albert Key, Herman Rosenfeld, and O. E. Tjoflat . . . 339
Atrophy and Delayed Calcification in Fractured Bones, The Use of Hydrochloric Acid in Certain Cases of. Nelson W. Cornell, Alice R. Bernheim, and E. Cooper Person . . . 40
Attachment to the Hawley Table for the Treatment of Fractures of the Lumbar, Thoracic, and Cervical Spine, An. Ralph D. Padula . . . 1036
Autogenous Bone Graft, The. Willis C. Campbell . . . 694
Avulsion of the Anterior Superior Spine of the Ilium. A Case Report. Leslie V. Rush and H. Lowry Rush . . . 206
Avulsion Fracture of the Os Calcis. Abraham S. Rothberg . . . 218
Avulsion of Tendon of Attachment of Biceps Brachii. A Case Report. S. Perry Rogers . . . 197

B

Back Pain, Posterior Fasciotomy in the Treatment of. Clarence H. Heyman . . . 397
Balkan Medical Union . . . 489

PAGE

Band, Parham, A New Instrument for Passing the. Harry B. Macey 1047
Biceps Brachii, Avulsion of Tendon of Attachment of. A Case Report. S. Perry Rogers 197
Biceps Tendon, Fixation of the, (Nicola Operation), Morphological Changes Accompanying. An Experimental Study on Animals. W. I. Norton, O. A. Mortensen, and W. E. Sullivan 127
Bilateral Osteochondritis of the Pisiform. Report of a Case. Adolph A. Schmier and Maurice P. Meyers 789
Biological Photographic Association 804
Bladder, Urinary, Osteosarcoma of the Bony Pelvis Associated with Carcinoma of the. Rosemary Shoemaker and H. E. Robertson 169
Blind Nailing of the T Fracture of the Lower End of the Humerus Which Involves the Joint. O. L. Miller 933
Bolt, Corkscrew, Experiences with the. Robert K. Lippmann 735
Bone-Block Operations, End Results of a Series of. Drop-Foot. Hira E. Branch 141
[Bone-Drilling.] A New Electric Power Unit for Drilling and Sawing Bone. Wilbur J. Cox 1048
Bone Graft, The Autogenous. Willis C. Campbell 694
Bone and Joint Club of Indiana 1055
Bone Metastasis from Primary Carcinoma of the Lung. Report of an Unusual Case. Justin J. Stein 992
Bony Pelvis, Osteosarcoma of the, Associated with Carcinoma of the Urinary Bladder. Rosemary Shoemaker and H. E. Robertson 169
Book Reviews
Adams, Francis, Translator. The Genuine Works of Hippocrates 813
American Roentgen Ray Society. Consolidated Indices: 1903–1937 499
Andreesen, Remmer. Erkennung und Behandlung der Hirnschädelbrüche ... 1067
Appleton, Arthur B.; Hamilton, William J.; and Tehaperoff, Ivan C. C. Surface and Radiological Anatomy for Students and General Practitioners 232
Bade, Peter. Die Geschichte der Deutschen Orthopädischen Gesellschaft ... 1066
Barsky, Arthur Joseph. Plastic Surgery 236
Blencke, August, and Gocht, Hermann, Editors. Die orthopädische Weltliteratur 496
Boigey, Maurice. Lesions et traumatismes sportifs 813
Boyd, William. Surgical Pathology 233
Brocher, J. E. W. Der Kreuzschmerz in seiner Beziehung zur Wirbelsäule .. 814
Buckley, C. W., Editor. Chronic Rheumatic Diseases: Being the Fourth Annual Report of the British Committee on Chronic Rheumatic Diseases, Appointed by The Royal College of Physicians 238
Burckhardt, Hans. Der Meniscusschade. Seine Ätiologie und seine Begutachtung im Rahmen der allgemeinen Unfallbegutachtung 815
Callander, C. Latimer. Surgical Anatomy 812
Chaklin, V. D., Editor. Traumatology and Orthopaedics 1063
Christopher, Frederick, Editor. A Textbook of Surgery: By American Authors 1062
Crowe, H. Warren. Rheumatism 814
Deutsche Orthopädische Gesellschaft. Verhandlungen der Deutschen Orthopädischen Gesellschaft 1065
Dickson, Frank D., and Diveley, Rex L. Functional Disorders of the Foot. Their Diagnosis and Treatment 1060
Faber, Alexander. Untersuchungen über die Ätiologie und Pathogenese der angeborenen Hüftverrenkung. Eine röntgenologisch-erbklinische Studie 499
Ferguson, Albert B. Roentgen Diagnosis of the Extremities and Spine 495
Fisher, A. G. Timbrell. Treatment by Manipulation 1060
Flagg, Paluel J. The Art of Anaesthesia 1066
Forgue, E., and Aimes. Les "pièges" de la chirurgie en diagnostic et thérapeutique. Erreurs et fautes ou faits présumés tels. Conditions et limites de la responsabilité 1059
Fox, Herbert. Chronic Arthritis in Wild Mammals 817
Golden, Ross, Editor. Diagnostic Roentgenology 238
Goldhahn, Richard. Die Allgemeinbetäubung nach ihrem heutigen Stand... 1067
Goldstein, Kurt. The Organism. A Holistic Approach to Biology Derived from Pathological Data in Man 1064
Hellner, Hans. Unfall und Knochengeschwulst 502
Hosford, John P. Fractures and Dislocations in General Practice 817
Imperatori, Charles J., and Burman, Herman J. Diseases of the Nose and Throat 1065

PAGE

Iselin, Marc. Chirurgie de la main. Livre du praticien. Plaies, infections et traumatismes fermés ... 234
Jordan, Henry H. Orthopedic Appliances. The Principles and Practice of Brace Construction for the Use of Orthopedic Surgeons and Bracemakers 235
Kienböck, Robert. Röntgendiagnostik der Knochen- und Gelenkkrankheiten 237
Kovács, Richard, Editor. Year Book of Physical Therapy ... 236
Lange, Max. Der Muskelrheumatismus ... 817
von Lanz, T., and Wachsmuth, W. Praktische Anatomie. Ein Lehr- und Hilfsbuch der anatomischen Grundlagen ärztlichen Handelns ... 495
Lasher, Willis W. Industrial Surgery: Principles, Problems, and Practice ... 237
Leclerc, Georges-Claude. Les tumeurs malignes primitives des os. Classification, étude clinique et radiographique ... 232
Leriche, René. Physiologie et pathologie du tissu osseux ... 1061
Lorenz, Albert. Richtlinien praktischer Orthopädie ... 500
Mallet-Guy, Pierre. Le traitement non sanglant des fractures du rachis ... 497
Martius, Heinrich. Die Kreuzschmerzen der Frau. Ihre Deutung und Behandlung. Gynäkologische Orthopädie ... 820
Maxson, Louis H. Spinal Anesthesia ... 239
Mennell, James. The Science and Art of Joint Manipulation ... 503
Morrison, W. Wallace. Diseases of the Nose, Throat and Ear ... 501
Morton, Dudley J. Oh, Doctor! My Feet! ... 498
Murphy, William P. Anemia in Practice ... 819
Northrop, John H. Crystalline Enzymes. The Chemistry of Pepsin, Trypsin, and Bacteriophage ... 816
Oberholzer, J. Röntgendiagnostik der Gelenke mittels Doppelkontrastmethode 233
Pereira, Lisandro Leyva. Tratamiento racional de las fracturas y luxaciones 1063
Petitpierre, Marco. Die Wintersportverletzungen ... 813
Price, Weston A. Nutrition and Physical Degeneration. A Comparison of Primitive and Modern Diets and Their Effects ... 1067
Reckzeh, P. Bedeutung des "vorherigen Zustands" für die Begutachtung der Folgen von Betriebsunfällen ... 238
Royle, Norman D. The Functions of Human Voluntary Muscles ... 502
Saegesser, Max. Das Panaritium ... 501
Schinz, H. R.; Baensch, W.; and Friedl, E. Lehrbuch der Röntgendiagnostik 812
Scudder, Charles Locke. The Treatment of Fractures ... 494
Simon, René. Les traitements orthopédiques et chirurgicaux des rheumatismes chroniques ... 500
Snapper, I. Maladies osseuses. Maladie de Recklinghausen, maladie de Paget, lipoidoses osseuses, myelomes multiples ... 818
Stafford, George T. Sports for the Handicapped ... 1065
Stauss, Anton. Die Ätiologie der Hüftgelenkdeformitäten. Die Varusdeformität ein organisatorischer Effekt statisch-dynamischer Kräfte ... 498
Stimson, Barbara Bartlett. A Manual of Fractures and Dislocations ... 501
Strocker, O., Editor. Verhandlungen der Vereinigung der Orthopäden Wiens 502
Thorek, Max. Modern Surgical Technic ... 231
Tidy, H. Letheby, and Short, A. Rendle, Editors. The Medical Annual 1939 1064
Tregubov, S. L. The Fundamentals of Orthopaedic Surgery ... 497
Veil, Wolfgang H. Der Rheumatismus und die streptomykotische Symbiose. Pathologie und Therapie ... 819
Watermann, Hermann. Muskelmechanische Probleme bei Hüftgelenksgabelung, Pfannendachplastik und anderen Eingriffen an den unteren Gliedmassen. 816
Wesselow, O. L. V. S., and Page, C. Max, Editors. St. Thomas's Hospital Reports ... 815
Whitman, Armitage. From Head to Foot ... 816

Bordeaux Orthopaedic Society ... 491, 807
[**Brace.**] An Appliance for the Prevention of Recurrent Dislocation of the Shoulder. Josef Wolf ... 472
Brace, Internal-Rotation-, Treatment of Epiphyseal Coxa Anteverta (Early Epiphysiolysis). Henry Milch ... 752
Brickner, Walter M., Lecture (Hospital for Joint Diseases) ... 224
British Orthopaedic Association ... 224, 226, 490, 805, 809

C

Calcaneotibial Arthrodesis, Amputation of the Foot, with. H. B. Boyd ... 997
Calcaneovalgus, Astragalectomy and the Treatment of. T. Campbell Thompson 627
Calcification, Delayed, in Fractured Bones, The Use of Hydrochloric Acid in Certain Cases of Atrophy and. Nelson W. Cornell, Alice R. Bernheim, and E. Cooper Person ... 40

PAGE

Calcium and Phosphorus Metabolism in Ossifying Fibroma of the Mandible, The. Karl P. Klassen and George M. Curtis 444
[**Calculi,** Renal.] Nephrolithiasis Occurring in Recumbency. R. Guy Pulvertaft 559
[**Calvé-Legg-Perthes Disease.**] Coxa Plana. Report of Two Bilateral Cases in Brothers. Walter H. Hagen 1028
Cancer, Skeletal Metastasis in. Charles F. Geschickter and I. H. Maseritz 314
Carcinoma of the Gastro-Intestinal Tract, Metastasis to Bone from. Ralph K. Ghormley and Jorge E. Valls 74
Carcinoma, Primary, of the Lung, Bone Metastasis from. Report of an Unusual Case. Justin J. Stein 992
[**Carcinoma.**] Skeletal Metastasis in Cancer. Charles F. Geschickter and I. H. Maseritz 314
Carcinoma of the Urinary Bladder, Osteosarcoma of the Bony Pelvis Associated with. Rosemary Shoemaker and H. E. Robertson 169
Carpal Navicular, Fractures of the. Importance of Special Roentgenography. Abraham S. Rothberg 1020
Carpal Navicular, Isolated Dislocation of the. A Case Report. Joseph R. Kuth. 479
Carpal Navicular, Treatment of Ununited Fractures of the. J. M. Edelstein 902
[**Carpus.**] Bilateral Osteochondritis of the Pisiform. Report of a Case. Adolph A. Schmier and Maurice P. Meyers. 789
[**Carpus.**] Dislocation of the Hamate Bone. Report of a Case. Donald C. Geist 215
[**Carpus.**] Kienböck's Disease of the Lunate. Edwin French Cave 858
Cartilages of the Patella and the Femoral Condyle, Injuries to the. V. D. Chaklin 133
[**Cartilage,** Semilunar.] A New Knife for the Removal of the Meniscus. Walter Mercer 474
Case of Freiberg's Disease Treated by a Walking Cast, A. Eugene L. Jewett 778
Cast, Plaster, A Simple Leg Elevator Incorporated in a. Sidney Sideman 1045
Cast, Walking, A Case of Freiberg's Disease Treated by a. Eugene L. Jewett . . . 778
Cellophane, The Use of, as a Permanent Tendon Sheath. Thomas Wheeldon . . . 393
Cervical Spine, Fractures of the Lumbar, Thoracic, and, An Attachment to the Hawley Table for the Treatment of. Ralph D. Padula 1036
Chondro-Osteodystrophy (Morquio's Disease). Progressive Kyphosis from Congenital Wedge-Shaped Vertebrae. John F. Pohl 187
[**Chorea,** Posthemiplegic.] The Diagnosis and Treatment of Athetosis and Dystonia. Tracy J. Putnam 948
[**Chronic Osteitis.**] Kienböck's Disease of the Lunate. Edwin French Cave 858
Clinical Orthopaedic Society 1055
Club-Foot, Congenital, Principles Involved in the Treatment of. J. H. Kite 595
[**Club-Foot.**] Utilization of the Body Weight in Treatment of the Residual Deformity in Club Feet. R. Saunders Melville 456
Club-Hand Deformity, Congenital, Associated with Absence of Radius: Its Surgical Correction. A Case Report. Arthur J. Davidson and M. Thomas Horwitz . . 462
Colonna Reconstruction Operation for Ununited Fractures of the Neck of the Femur, The. Analysis of Seventy Cases. Paul C. Colonna 701
Committee, Fracture, of the American Academy of Orthopaedic Surgeons, Report of the. Treatment of Fractures of the Neck of the Femur by Internal Fixation. M. N. Smith-Petersen and H. Earle Conwell 483
Common Peroneal Nerve, Division of the, Complete Medial Dislocation of the Knee Joint with. John A. Ferguson and Lyman Allen 1012
Compensation-Derotation Treatment of Scoliosis, The. A. Steindler, William R. Hamsa, and William Cooper 51
Complete Medial Dislocation of the Knee Joint with Division of the Common Peroneal Nerve. John A. Ferguson and Lyman Allen 1012
Compound Dislocation of the Tibiotalar Joint without Fracture and without Separation. Charles Haines 205
Compression Fractures of the Lateral Tibial Condyle and Their Treatment. Ivar Palmer 674
Condyle, Lateral, of the Humerus, Regeneration of the, after Excision. Allen F. Voshell and K. P. A. Taylor 421
Condyle, Lateral Tibial, Compression Fractures of the, and Their Treatment. Ivar Palmer 674
Congenital Absence of the Ramus of the Mandible. V. H. Kazanjian 761
Congenital Bilateral Talipes Equinus in Twins. Paul W. Lapidus 79
Congenital Club-Foot, Principles Involved in the Treatment of. J. H. Kite 59
Congenital Club-Hand Deformity Associated with Absence of Radius: Its Surgical Correction. A Case Report. Arthur J. Davidson and M. Thomas Horwitz . . 4

PAGE

Congenital Convex Pes Valgus. L. Lamy and L. Weissman 79
Congenital Dislocation of the Hip, Arthrography in. Erik Severin 304
Congenital Dislocation of the Hip, Primary Anterior. H. R. McCarroll and C. H. Crego, Jr. 648
Congenital Dislocation of the Hip, Early, The Use of Skeletal Traction as a Preliminary Procedure in the Treatment of. C. H. Crego, Jr. 353
Congenital Dislocation of the Sacro-Iliac Joint, Unilateral Congenital Elevation of the Ilium or. A Rare Anomaly. Daniel H. Levinthal and Irving Wolin 193
Congenital Posterior Position of the Medial Epicondyle of the Humerus, Recurrent Luxation of the Ulnar Nerve by. Michael S. Burman and Charles J. Sutro 958
Congenital Unilateral Absence of the Medial Sesamoid of the Great Toe. Report of a Case. Paul W. Lapidus 208
Congenital Wedge-Shaped Vertebrae, Progressive Kyphosis from. Chondro-Osteodystrophy (Morquio's Disease). John F. Pohl 187
Contracture, Dupuytren's, of Palmar and Plantar Fasciae. Lewis Greenberg 785
Contracture, Volkmann's, as a Complication of Fractures of the Forearm and Elbow. J. Neill Garber 154
Coracoclavicular Joint. Borivoye Gradoyevitch 918
Corkscrew Bolt, Experiences with the. Robert K. Lippmann 735
Coxa Anteverta, Epiphyseal (Early Epiphysiolysis), Internal-Rotation-Brace Treatment of. Henry Milch 752
Coxalgia, Pathogenesis of the Limp Due to. The Antalgic Gait. Jacques Calvé, Marcel Galland, and Roger de Cagny 12
Coxa Plana. Report of Two Bilateral Cases in Brothers. Walter H. Hagen 1028
Coxitis, Tuberculous, in Children, A New Operative Treatment of. Aladár Farkas 323
[**Cripples.**] International Exhibition of Cripples' Work 489
[**Cripples.**] World Conference of Workers for Cripples 491, 1057
Cruciate Ligament, Anterior, Ossification in the. Robert S. Garden 1027
Current Literature 231, 494, 812, 1059
[**Curvature,** Lateral.] The Compensation-Derotation Treatment of Scoliosis. A. Steindler, William R. Hamsa, and William Cooper 51
[**Curvature,** Lateral.] Experimental Production of Scoliosis. S. L. Haas 963

D

Dane, John 799
Deformities, The Recurrence of Flexion and Adduction, Following Operative Fusion of the Hip and Subtrochanteric Osteotomy. F. Harold Downing 909
Derotation, The Compensation-, Treatment of Scoliosis. A. Steindler, William R. Hamsa, and William Cooper 51
Deutsche Gesellschaft für Unfallheilkunde, Versicherungs- und Versorgungsmedizin 804, 1055
Deutsche Orthopädische Gesellschaft 805
Diagnosis and Treatment of Athetosis and Dystonia, The. Tracy J. Putnam ... 948
Direct Leverage in the Treatment of Gunshot Fractures of the Forearm. Francisco P. Dueño 373
Disc, Intervertebral. Rupture of the Nucleus Pulposus. An Anatomical Study. Martin Batts, Jr. 121
[**Disease,** Calvé-Legg-Perthes.] Coxa Plana. Report of Two Bilateral Cases in Brothers. Walter H. Hagen 1028
Disease, Freiberg's, A Case of, Treated by a Walking Cast. Eugene L. Jewett ... 778
Disease, Kienböck's, of the Lunate. Edwin French Cave 858
[**Disease,** Köhler's.] A Case of Freiberg's Disease Treated by a Walking Cast. Eugene L. Jewett 778
[**Disease,** Köhler's.] Osteochondritis of the Adult Tarsal Navicular. James F. Brailsford 111
(**Disease,** Morquio's), Chondro-Osteodystrophy. Progressive Kyphosis from Congenital Wedge-Shaped Vertebrae. John F. Pohl 187
Dislocations, Ankle, without Fracture. Milton J. Wilson, Arthur A. Michele, and Edwin W. Jacobson 198
Dislocation, Complete Medial, of the Knee Joint with Division of the Common Peroneal Nerve. John A. Ferguson and Lyman Allen 1012
Dislocation, Compound, of the Tibiotalar Joint without Fracture and without Separation. Charles Haines 205
location, Congenital, of the Hip, Arthrography in. Erik Severin 304
location, Congenital, of the Hip, The Use of Skeletal Traction as a Preliminary Procedure in the Treatment of Early. C. H. Crego, Jr. 353

PAGE

Dislocation, Congenital, of the Sacro-Iliac Joint, Unilateral Congenital Elevation of the Ilium or. A Rare Anomaly. Daniel H. Levinthal and Irving Wolin . . 193
Dislocation, Habitual, of the Distal End of the Ulna. Report of a Case. Robert B. Hill 780
Dislocation of the Hamate Bone. Report of a Case. Donald C. Geist 215
Dislocation, Isolated, of the Carpal Navicular. A Case Report. Joseph R. Kuth 479
Dislocation, Old, A Functioning False Shoulder Joint Following an. Kenneth Christophe 916
Dislocation, Primary Anterior Congenital, of the Hip. H. R. McCarroll and C. H. Crego, Jr. 648
[**Dislocation.**] Recurrent Luxation of the Ulnar Nerve by Congenital Posterior Position of the Medial Epicondyle of the Humerus. Michael S. Burman and Charles J. Sutro 958
Dislocation, Recurrent, of the Shoulder, An Appliance for the Prevention of. Josef Wolf 472
[**Dislocation,** Recurrent, of the Shoulder.] Morphological Changes Accompanying Fixation of the Biceps Tendon (Nicola Operation). An Experimental Study on Animals. W. I. Norton, O. A. Mortensen, and W. E. Sullivan 127
Dislocation, Traumatic, Aseptic Necrosis of Head of Femur Following. Frank N. Potts and Ben E. Obletz 101
Displaced Fractures of the Pelvis, A Method for Treating. Eugene L. Jewett 177
Division of the Common Peroneal Nerve, Complete Medial Dislocation of the Knee Joint with. John A. Ferguson and Lyman Allen 1012
Drilling and Sawing Bone, A New Electric Power Unit for. Wilbur J. Cox 1048
Drop-Foot. End Results of a Series of Bone-Block Operations. Hira E. Branch . . 141
[**Drop-Foot.**] Osteochondroma of the Fibula with Resultant Foot Drop. John T. Hodgen and Frances Brennecke 405
Dupuytren's Contracture of Palmar and Plantar Fasciae. Lewis Greenberg 785
Dystonia, The Diagnosis and Treatment of Athetosis and. Tracy J. Putnam 948
[**Dystrophy,** Osseous.] Chondro-Osteodystrophy (Morquio's Disease). Progressive Kyphosis from Congenital Wedge-Shaped Vertebrae. John F. Pohl 187

E

Elastic Straps to Prevent Slipping of a Knee Cage. Raphael R. Goldenberg 797
[**Elbow.**] Blind Nailing of the T Fracture of the Lower End of the Humerus Which Involves the Joint. O. L. Miller 933
[**Elbow.**] Operative Reconstruction of the Paralyzed Upper Extremity. Leo Mayer 377
[**Elbow.**] Regeneration of the Lateral Condyle of the Humerus after Excision. Allen F. Voshell and K. P. A. Taylor 421
Elbow, Volkmann's Contracture as a Complication of Fractures of the Forearm and. J. Neill Garber 154
Elbow Joint, Osteochondritis Dissecans of the. Frank G. Murphy 464
Electric Power Unit, A New, for Drilling and Sawing Bone. Wilbur J. Cox 1048
Elevation of the Ilium, Unilateral Congenital, or Congenital Dislocation of the Sacro-Iliac Joint. A Rare Anomaly. Daniel H. Levinthal and Irving Wolin 193
Elevator, A Simple Leg, Incorporated in a Plaster Cast. Sidney Sideman 1045
Epicondyle, Medial, of the Humerus, Recurrent Luxation of the Ulnar Nerve by Congenital Position of the. Michael S. Burman and Charles J. Sutro 958
Epiphyseal Coxa Anteverta (Early Epiphysiolysis), Internal-Rotation-Brace Treatment of. Henry Milch 752
Epiphysiodesis Combined with Amputation. Frederick vom Saal 442
Epiphysitis of the Os Calcis. Harold E. Simon and Byrn Williamson 1015
Ernst Freund 487
Etiology of Spondylolisthesis, The. Martin Batts, Jr. 879
Ewing's Sarcoma. Charles F. Geschickter and I. H. Maseritz 26
Experiences with the Corkscrew Bolt. Robert K. Lippmann 735
Experimental Fractures, Temperature-Controlled Healing of. Kellogg Speed and Egbert H. Fell 1005
Experimental Production of Scoliosis. S. L. Haas 963
Extra-Articular Method of Internal Fixation in Fractures of the Femoral Neck, A New Device for Facilitating the Taking of Roentgenograms When Performing the. J. I. Sloat and Leonard T. Peterson 1041

F

Fasciae, Palmar and Plantar, Dupuytren's Contracture of. Lewis Greenberg . . . 785
Fasciotomy, Posterior, in the Treatment of Back Pain. Clarence H. Heyman . . . 397
Femoral Condyle, Injuries to the Cartilages of the Patella and the. V. D. Chaklin 133

PAGE

Femoral Neck, Fractures of the, A New Device for Facilitating the Taking of Roentgenograms When Performing the Extra-Articular Method of Internal Fixation in. J. I. Sloat and Leonard T. Peterson 1041
Femoral-Neck Fractures, Objections to the Use of Kirschner Wire for Fixation of. Seth Selig 182
Femoral Shaft, Overgrowth of the, Following Fracture in Childhood. Alexander P. Aitken, Charles W. Blackett, and John J. Cincotti 334
Femur, Arthrodesis for Ununited Fracture of the Neck of the. A. Bruce Gill ... 710
[**Femur.**] Arthrography in Congenital Dislocation of the Hip. Erik Severin ... 304
[**Femur.**] Arthroplasty of the Hip. A New Method. M. N. Smith-Petersen ... 269
Femur, Aseptic Necrosis of Head of, Following Traumatic Dislocation. Frank N. Potts and Ben E. Obletz 101
Femur, The Colonna Reconstruction Operation for Ununited Fractures of the Neck of the. Analysis of Seventy Cases. Paul C. Colonna 701
[**Femur.**] Coxa Plana. Report of Two Bilateral Cases in Brothers. Walter H. Hagen 1028
[**Femur.**] Internal-Rotation-Brace Treatment of Epiphyseal Coxa Anteverta (Early Epiphysiolysis). Henry Milch 752
[**Femur,** Intracapsular Fracture of the.] Experiences with the Corkscrew Bolt. Robert K. Lippmann 735
[**Femur.**] Isolated Fracture of the Lesser Trochanter. Milton J. Wilson, Arthur A. Michele, and Edwin W. Jacobson 776
[**Femur.**] Movable Traction Carrier. An Apparatus for Combining Traction with Motion at the Hip. Alvin M. Arkin 1032
[**Femur.**] A New Operative Treatment of Tuberculous Coxitis in Children. Aladár Farkas 323
Femur, Open Fixation of Intracapsular Fracture of the. An Improved Technique. Otho C. Hudson and William P. Bartels 1001
[**Femur.**] Osteo-Arthritis of the Hip Joint. T. P. McMurray 1
Femur, The Pathology of Ununited Fractures of the, with Special Reference to the Head. Dallas B. Phemister 681
[**Femur.**] Primary Anterior Congenital Dislocation of the Hip. H. R. McCarroll and C. H. Crego, Jr. 648
[**Femur.**] The Recurrence of Flexion and Adduction Deformities Following Operative Fusion of the Hip and Subtrochanteric Osteotomy. F. Harold Downing 909
[**Femur.**] A Simplified Directional Guide for Hip Nailing. C. Fred Ferciot 1023
Femur, Supracondylar Fracture of the, with Anterior Position of the Lower Fragment. Drury Hinton 719
Femur, A Technique for Longitudinal Pin Fixation of Certain Fractures of the Ulna and of the. Leslie V. Rush and H. Lowry Rush 619
Femur, Treatment of Fractures of the Neck of the, by Internal Fixation. Report of the Fracture Committee of the American Academy of Orthopaedic Surgeons. M. N. Smith-Petersen and H. Earle Conwell 483
[**Femur.**] The Treatment of Intertrochanteric Fractures. William P. Bartels .. 773
Femur, Treatment of Obstetrical Fractures of the. Arnold Pavlík 939
[**Femur.**] The Use of Skeletal Traction as a Preliminary Procedure in the Treatment of Early Congenital Dislocation of the Hip. C. H. Crego, Jr. 353
[**Femur.**] The Whitman Reconstruction Operation. Royal Whitman 1051
Fever, Undulant, Vertebral Lesions in. W. A. Bishop, Jr. 665
Fibroma, Ossifying, of the Mandible, The Calcium and Phosphorus Metabolism in. Karl P. Klassen and George M. Curtis 444
Fibula, Osteochondroma of the, with Resultant Foot Drop. John T. Hodgen and Frances Brennecke 405
[**Fingers.**] Dupuytren's Contracture of Palmar and Plantar Fasciae. Lewis Greenberg 785
[**Fingers.**] Reconstruction of Thumb after Traumatic Amputation. Donald E. Dial 98
Finger, An Unusual Fracture of the Terminal Phalanx of the. Robert A. Wise 467
[**Fingers.**] Volkmann's Contracture as a Complication of Fractures of the Forearm and Elbow. J. Neill Garber 154
Fissure Formation in Articular Facets of the Lumbar Spine. Operative Findings in One Case. Herbert E. Hipps 289
Fixation of the Biceps Tendon (Nicola Operation), Morphological Changes Accompanying. An Experimental Study on Animals. W. I. Norton, O. A. Mortensen, and W. E. Sullivan 127
Fixation of Femoral-Neck Fractures, Objections to the Use of Kirschner Wire for. Seth Selig 182

PAGE

Fixation of Fractures, A Sleeved-Wire Method of. Thomas Wheeldon 210
Fixation, Internal, Extra-Articular Method of, in Fractures of the Femoral Neck, A New Device for Facilitating the Taking of Roentgenograms When Performing the. J. I. Sloat and Leonard T. Peterson 1041
Fixation, Internal, Treatment of Fractures of the Neck of the Femur by. Report of the Fracture Committee of the American Academy of Orthopaedic Surgeons. M. N. Smith-Petersen and H. Earle Conwell 483
Fixation, Longitudinal Pin, of Certain Fractures of the Ulna and of the Femur, A Technique for. Leslie V. Rush and H. Lowry Rush 619
Fixation, Open, of Intracapsular Fracture of the Femur. An Improved Technique. Otho C. Hudson and William P. Bartels 1001
[**Flat-Foot.**] Congenital Convex Pes Valgus. L. Lamy and L. Weissman 79
[**Flat-Foot.**] The Hoke Operation for Flat Feet. Joseph B. L'Episcopo and Peter E. Sabatelle 92
Flexion and Adduction Deformities, The Recurrence of, Following Operative Fusion of the Hip and Subtrochanteric Osteotomy. F. Harold Downing 909
Florida Medical Center 489
Foot, Amputation of the, with Calcaneotibial Arthrodesis. H. B. Boyd 997
[**Foot.**] Congenital Bilateral Talipes Equinus in Twins. Paul W. Lapidus 792
[**Foot.**] Congenital Convex Pes Valgus. L. Lamy and L. Weissman 79
[**Foot.**] Drop-Foot. End Results of a Series of Bone-Block Operations. Hira E. Branch 141
[**Foot.**] The Hoke Operation for Flat Feet. Joseph B. L'Episcopo and Peter E. Sabatelle 92
[**Foot.**] Osteochondritis of the Adult Tarsal Navicular. James F. Brailsford 111
[**Foot.**] Principles Involved in the Treatment of Congenital Club-Foot. J. H. Kite 595
[**Foot.**] The Treatment of Fractures of the Os Calcis. Paul F. Olson 747
Foot Drop, Osteochondroma of the Fibula with Resultant. John T. Hodgen and Frances Brennecke 405
[**Forearm.**] Avulsion of Tendon of Attachment of Biceps Brachii. A Case Report. S. Perry Rogers 197
Forearm, Direct Leverage in the Treatment of Gunshot Fractures of the. Francisco P. Dueño 373
Forearm and Elbow, Volkmann's Contracture as a Complication of Fractures of the. J. Neill Garber 154
Fracture of an Articular Process. Maurice H. Herzmark 1031
Fracture, Avulsion of the Os Calcis. Abraham S. Rothberg 218
Fractures of the Carpal Navicular. Importance of Special Roentgenography. Abraham S. Rothberg 1020
Fracture in Childhood, Overgrowth of the Femoral Shaft Following. Alexander P. Aitken, Charles W. Blackett, and John J. Cincotti 334
Fracture, Compression, Acute Osteomyelitis of a Vertebral Body Following. Rodney F. Atsatt 346
Fractures, Compression, of the Lateral Tibial Condyle and Their Treatment. Ivar Palmer 674
Fractures, Displaced, of the Pelvis, A Method for Treating. Eugene L. Jewett 177
Fractures, Experimental, Temperature-Controlled Healing of. Kellogg Speed and Egbert H. Fell 1005
Fractures of the Femoral Neck, A New Device for Facilitating the Taking of Roentgenograms When Performing the Extra-Articular Method of Internal Fixation in. J. I. Sloat and Leonard T. Peterson 1041
Fractures, Femoral-Neck, Objections to the Use of Kirschner Wire for Fixation of. Seth Selig 182
Fractures of the Forearm and Elbow, Volkmann's Contracture as a Complication of. J. Neill Garber 154
Fractures, Gunshot, of the Forearm, Direct Leverage in the Treatment of. Francisco P. Dueño 373
Fractures, Intertrochanteric, The Treatment of. William P. Bartels 773
[**Fracture,** Intracapsular, of the Femur.] Experiences with the Corkscrew Bolt. Robert K. Lippmann 735
Fracture, Intracapsular, of the Femur, Open Fixation of. An Improved Technique. Otho C. Hudson and William P. Bartels 1001
Fracture, Isolated, of the Lesser Trochanter. Milton J. Wilson, Arthur A. Michele, and Edwin W. Jacobson 776
Fractures of the Lumbar, Thoracic, and Cervical Spine, An Attachment to the Hawley Table for the Treatment of. Ralph D. Padula 1036

PAGE

Fractures of the Neck of the Femur, Treatment of, by Internal Fixation. Report of the Fracture Committee of the American Academy of Orthopaedic Surgeons. M. N. Smith-Petersen and H. Earle Conwell ... 483
Fractures, Obstetrical, of the Femur, Treatment of. Arnold Pavlík ... 939
Fractures of the Os Calcis, The Treatment of. Paul F. Olson ... 747
Fractures of the Pelvis. Management by Use of a Posterior Plaster-of-Paris Shell. G. J. Curry ... 384
[**Fracture.**] Pseudofracture of the Tibia. Sumner M. Roberts and Edward C. Vogt ... 891
Fracture of the Scapula Requiring Open Reduction. Report of a Case. Walter R. Fischer ... 459
Fractures, A Sleeved-Wire Method of Fixation of. Thomas Wheeldon ... 210
Fracture, Supracondylar, of the Femur with Anterior Position of the Lower Fragment. Drury Hinton ... 719
Fracture, T, of the Lower End of the Humerus Which Involves the Joint, Blind Nailing of the. O. L. Miller ... 933
Fractures, Transcondylar, of the Humerus in Childhood. John Dunlop ... 59
Fractures of the Ulna and of the Femur, A Technique for Longitudinal Pin Fixation of Certain. Leslie V. Rush and H. Lowry Rush ... 619
Fractures, Ununited, of the Carpal Navicular, Treatment of. J. M. Edelstein ... 902
Fracture, Ununited, of the Neck of the Femur, Arthrodesis for. A. Bruce Gill ... 710
Fractures, Ununited, of the Neck of the Femur, The Colonna Reconstruction Operation for. Analysis of Seventy Cases. Paul C. Colonna ... 701
Fractures, Ununited, of the Neck of the Femur, The Pathology of, with Special Reference to the Head. Dallas B. Phemister ... 681
[**Fractures,** Ununited.] Synostosis Operation for Persistent Non-Union of the Tibia. A Case Report. Henry Milch ... 409
Fracture, An Unusual, of the Terminal Phalanx of the Finger. Robert A. Wise ... 467
Fracture Committee of the American Academy of Orthopaedic Surgeons, Report of the. Treatment of Fractures of the Neck of the Femur by Internal Fixation. M. N. Smith Petersen and H. Earle Conwell ... 483
Fractured Bones, The Use of Hydrochloric Acid in Certain Cases of Atrophy and Delayed Calcification in. Nelson W. Cornell, Alice R. Bernheim, and E. Cooper Person ... 40
Frederick Howard Marsh ... 811
Freiberg's Disease, A Case of, Treated by a Walking Cast. Eugene L. Jewett ... 778
French Society of Orthopaedic and Traumatic Surgery ... 224
Freund, Ernst ... 487
Functioning False Shoulder Joint Following an Old Dislocation, A. Kenneth Christophe ... 916
[**Fusion,** Epiphyseal.] Epiphysiodesis Combined with Amputation. Frederick vom Saal ... 442
Fusion, Operative, of the Hip and Subtrochanteric Osteotomy, The Recurrence of Flexion and Adduction Deformities Following. F. Harold Downing ... 909

G

Gait, The Antalgic. Pathogenesis of the Limp Due to Coxalgia. Jacques Calvé, Marcel Galland, and Roger de Cagny ... 12
Galloway, Herbert Peter Howell ... 1052
Gastro-Intestinal Tract, Metastasis to Bone from Carcinoma of the. Ralph K. Ghormley and Jorge E. Valls ... 74
Generalized Myositis Fibrosa. Report of a Case. Donald C. Somers ... 414
German Orthopaedic Society ... 805
German Society for Industrial Surgery and Institutional Medicine ... 804, 1055
Giant-Cell Tumor, Malignant, of Bone. Report of a Case Involving the Tibia. Samuel Kleinberg ... 433
[**Glass-Mold Arthroplasty.**] Arthroplasty of the Hip. A New Method. M. N. Smith-Petersen ... 269
Gold Therapy in Proliferative (Especially Atrophic) Arthritis. J. Albert Key, Herman Rosenfeld, and O. E. Tjoflat ... 339
Gold Therapy in Rheumatoid Arthritis. David Sashin, Joseph Spanbock, and David H. Kling ... 723
Goniometer, A Serviceable, with Supination-Pronation Attachment. Herbert W. Virgin, Jr ... 221
Graft, The Autogenous Bone. Willis C. Campbell ... 694
Guide, A Simplified Directional, for Hip Nailing. C. Fred Ferciot ... 1023
Gunshot Fractures, of the Forearm, Direct Leverage in the Treatment of. Francisco P. Dueño ... 373

PAGE

H

Habitual Dislocation of the Distal End of the Ulna. Report of a Case. Robert B. Hill ... 780
Hamate Bone, Dislocation of the. Report of a Case. Donald C. Geist ... 215
Hammer-Toe, Operation for Correction of. Paul W. Lapidus ... 977
[**Hand.**] Congenital Club-Hand Deformity Associated with Absence of Radius: Its Surgical Correction. A Case Report. Arthur J. Davidson and M. Thomas Horwitz ... 462
[**Hand.**] Operative Reconstruction of the Paralyzed Upper Extremity. Leo Mayer ... 377
Hawley Table, Arm Control for Operations on the Upper Extremity on the. George W. Hawley ... 794
Hawley Table, An Attachment to the, for the Treatment of Fractures of the Lumbar, Thoracic, and Cervical Spine. Ralph D. Padula ... 1036
Healing, Temperature-Controlled, of Experimental Fractures. Kellogg Speed and Egbert H. Fell ... 1005
[**Heel.**] Avulsion Fracture of the Os Calcis. Abraham S. Rothberg ... 218
[**Heel.**] Epiphysitis of the Os Calcis. Harold E. Simon and Byrn Williamson ... 1015
[**Heel.**] The Treatment of Fractures of the Os Calcis. Paul F. Olson ... 747
Herbert Peter Howell Galloway ... 1052
Hip, An Apparatus for Combining Traction with Motion at the. Movable Traction Carrier. Alvin M. Arkin ... 1032
[**Hip.**] Arthrodesis for Ununited Fracture of the Neck of the Femur. A. Bruce Gill ... 710
Hip, Arthrography in Congenital Dislocation of the. Erik Severin ... 304
Hip, Arthroplasty of the. A New Method. M. N. Smith-Petersen ... 269
[**Hip.**] Aseptic Necrosis of Head of Femur Following Traumatic Dislocation. Frank N. Potts and Ben E. Obletz ... 101
[**Hip.**] Avulsion of the Anterior Superior Spine of the Ilium. A Case Report. Leslie V. Rush and H. Lowry Rush ... 206
[**Hip.**] The Colonna Reconstruction Operation for Ununited Fractures of the Neck of the Femur. Analysis of Seventy Cases. Paul C. Colonna ... 701
[**Hip.**] Coxa Plana. Report of Two Bilateral Cases in Brothers. Walter H. Hagen ... 1028
[**Hip.**] Experiences with the Corkscrew Bolt. Robert K. Lippmann ... 735
[**Hip.**] Internal-Rotation-Brace Treatment of Epiphyseal Coxa Anteverta (Early Epiphysiolysis). Henry Milch ... 752
[**Hip.**] Isolated Fracture of the Lesser Trochanter. Milton J. Wilson, Arthur A. Michele, and Edwin W. Jacobson ... 776
[**Hip.**] A New Device for Facilitating the Taking of Roentgenograms When Performing the Extra-Articular Method of Internal Fixation in Fractures of the Femoral Neck. J. I. Sloat and Leonard T. Peterson ... 1041
[**Hip.**] A New Operative Treatment of Tuberculous Coxitis in Children. Aladár Farkas ... 323
[**Hip.**] Objections to the Use of Kirschner Wire for Fixation of Femoral-Neck Fractures. Seth Selig ... 182
[**Hip.**] Open Fixation of Intracapsular Fracture of the Femur. An Improved Technique. Otho C. Hudson and William P. Bartels ... 1001
[**Hip.**] Pathogenesis of the Limp Due to Coxalgia. The Antalgic Gait. Jacques Calvé, Marcel Galland, and Roger de Cagny ... 12
[**Hip.**] The Pathology of Ununited Fractures of the Neck of the Femur with Special Reference to the Head. Dallas B. Phemister ... 681
Hip, Primary Anterior Congenital Dislocation of the. H. R. McCarroll and C. H. Crego, Jr. ... 648
Hip, The Recurrence of Flexion and Adduction Deformities Following Operative Fusion of the, and Subtrochanteric Osteotomy. F. Harold Downing ... 909
[**Hip.**] Treatment of Fractures of the Neck of the Femur by Internal Fixation. Report of the Fracture Committee of the American Academy of Orthopaedic Surgeons. M. N. Smith-Petersen and H. Earle Conwell ... 483
[**Hip.**] The Treatment of Intertrochanteric Fractures. William P. Bartels ... 773
[**Hip.**] Treatment of Obstetrical Fractures of the Femur. Arnold Pavlík ... 939
Hip, The Use of Skeletal Traction as a Preliminary Procedure in the Treatment of Early Congenital Dislocation of the. C. H. Crego, Jr. ... 353
[**Hip.**] The Whitman Reconstruction Operation. Royal Whitman ... 1051
Hip Joint, Osteo-Arthritis of the. T. P. McMurray ... 1
Hip Nailing, A Simplified Directional Guide for. C. Fred Ferciot ... 1023
Hoffmann, Philip ... 800

PAGE

Hoke Operation for Flat Feet, The. Joseph B. L'Episcopo and Peter E. Sabatelle 92
Hospital for Joint Diseases 224, 489, 804
Humerus, Blind Nailing of the T Fracture of the Lower End of the, Which Involves the Joint. O. L. Miller 933
Humerus, Recurrent Luxation of the Ulnar Nerve by Congenital Posterior Position of the Medial Epicondyle of the. Michael S. Burman and Charles J. Sutro 958
Humerus, Regeneration of the Lateral Condyle of the, after Excision. Allen F. Voshell and K. P. A. Taylor 421
Humerus, Transcondylar Fractures of the, in Childhood. John Dunlop 59
Hydrochloric Acid, The Use of, in Certain Cases of Atrophy and Delayed Calcification in Fractured Bones. Nelson W. Cornell, Alice R. Bernheim, and E. Cooper Person 40

I

Ilium, Avulsion of the Anterior Superior Spine of the. A Case Report. Leslie V. Rush and H. Lowry Rush 206
Ilium, Unilateral Congenital Elevation of the, or Congenital Dislocation of the Sacro-Iliac Joint. A Rare Anomaly. Daniel H. Levinthal and Irving Wolin 193
[**Infantile Paralysis.**] The Methods Used in Handling the Epidemic of Poliomyelitis in Ontario in 1937. A. B. LeMesurier 867
[**Infantile Paralysis.**] A Muscle Tester for Poliomyelitis Cases. Attachment for a Permanent Record. Adolph A. Schmier 475
[**Infantile Paralysis.**] An Operation to Improve Abduction Power of the Shoulder in Poliomyelitis. Alvia Brockway 451
[**Infraction,** Freiberg's.] A Case of Freiberg's Disease Treated by a Walking Cast. Eugene L. Jewett 778
Injuries to the Cartilages of the Patella and the Femoral Condyle. V. D. Chaklin 133
Insulin, The Use of, as an Adjunct in the Treatment of Bone and Joint Tuberculosis. Russell L. Nichols and Edward L. Compere 885
Internal Fixation, Extra-Articular Method of, in Fractures of the Femoral Neck, A New Device for Facilitating the Taking of Roentgenograms When Performing the. J. I. Sloat and Leonard T. Peterson 1041
Internal Fixation, Treatment of Fractures of the Neck of the Femur by. Report of the Fracture Committee of the American Academy of Orthopaedic Surgeons. M. N. Smith-Petersen and H. Earle Conwell 483
Internal-Rotation-Brace Treatment of Epiphyseal Coxa Anteverta (Early Epiphysiolysis). Henry Milch 752
International Congress for Industrial Medicine and Occupational Diseases 806
International Exhibition of Cripples' Work 489
International Society of Orthopaedic Surgery and Traumatology 805
Internationaler Kongress für Unfallmedizin und Berufskrankheiten 806
Intertrochanteric Fractures, The Treatment of. William P. Bartels 773
[**Intervertebral Disc.**] Rupture of the Nucleus Pulposus. An Anatomical Study. Martin Batts, Jr. 121
[**Intracapsular Fracture** of the Femur.] Experiences with the Corkscrew Bolt. Robert K. Lippmann 735
Intracapsular Fracture of the Femur, Open Fixation of. An Improved Technique. Otho C. Hudson and William P. Bartels 1001
Invalid-Lifting Apparatus, An. Robert D. Maddox 470
Isolated Dislocation of the Carpal Navicular. A Case Report. Joseph R. Kuth . . 479
Isolated Fracture of the Lesser Trochanter. Milton J. Wilson, Arthur A. Michele, and Edwin W. Jacobson 776
Istituto Ortopedico Rizzoli 489
Italian Society of Orthopaedic and Traumatic Surgery 491

J

[**Jaw.**] Congenital Absence of the Ramus of the Mandible. V. H. Kazanjian 761
John Dane 799
Joint Tuberculosis, Surgical Treatment of. Mather Cleveland 607
Jones, Sir Robert, Lecture (Hospital for Joint Diseases) 489
Joseph Edgar Stewart 801

K

Kienböck's Disease of the Lunate. Edwin French Cave 858
Kirschner Wire, Objections to the Use of, for Fixation of Femoral-Neck Fractures. Seth Selig 182

PAGE

[**Knee.**] Compression Fractures of the Lateral Tibial Condyle and Their Treatment. Ivar Palmer 674
[**Knee.**] Injuries to the Cartilages of the Patella and the Femoral Condyle. V. D. Chaklin 133
[**Knee.**] Ossification in the Anterior Cruciate Ligament. Robert S. Garden 1027
Knee Cage, Elastic Straps to Prevent Slipping of a. Raphael R. Goldenberg 797
Knee Joint, Complete Medial Dislocation of the, with Division of the Common Peroneal Nerve. John A. Ferguson and Lyman Allen 1012
Knife, A New, for the Removal of the Meniscus. Walter Mercer 474
[**Köhler's Disease.**] A Case of Freiberg's Disease Treated by a Walking Cast. Eugene L. Jewett 778
[**Köhler's Disease.**] Osteochondritis of the Adult Tarsal Navicular. James F. Brailsford 111
Kyphosis, Progressive, from Congenital Wedge-Shaped Vertebrae. Chondro-Osteodystrophy (Morquio's Disease). John F. Pohl 187

L

Lateral Condyle of the Humerus, Regeneration of the, after Excision. Allen F. Voshell and K. P. A. Taylor 421
[**Lateral Curvature.**] The Compensation-Derotation Treatment of Scoliosis. A. Steindler, William R. Hamsa, and William Cooper 51
[**Lateral Curvature.**] Experimental Production of Scoliosis. S. L. Haas 963
Lateral Tibial Condyle, Compression Fractures of the, and Their Treatment. Ivar Palmer 674
Lecture, Sir Robert Jones (Hospital for Joint Diseases) 489
Lecture, Walter M. Brickner (Hospital for Joint Diseases) 224
Leg Elevator, A Simple, Incorporated in a Plaster Cast. Sidney Sideman 1045
Legg, Arthur Thornton 1054
Lesser Trochanter, Isolated Fracture of the. Milton J. Wilson, Arthur A. Michele, and Edwin W. Jacobson 776
Leverage, Direct, in the Treatment of Gunshot Fractures of the Forearm. Francisco P. Dueño 373
Ligament, Anterior Cruciate, Ossification in the. Robert S. Garden 1027
Limp Due to Coxalgia, Pathogenesis of the. The Antalgic Gait. Jacques Calvé, Marcel Galland, and Roger de Cagny 12
Long Bones, Tuberculosis of the. A Report of Six Cases. Frank C. Hodges 148
Longitudinal Pin Fixation of Certain Fractures of the Ulna and of the Femur, A Technique for. Leslie V. Rush and H. Lowry Rush 619
[**Low-Back Disabilities.**] Fissure Formation in Articular Facets of the Lumbar Spine. Operative Findings in One Case. Herbert E. Hipps 289
[**Low-Back Disabilities.**] Posterior Fasciotomy in the Treatment of Back Pain. Clarence H. Heyman 397
Lumbar Spine, Fissure Formation in Articular Facets of the. Operative Findings in One Case. Herbert E. Hipps 289
Lumbar, Thoracic, and Cervical Spine, Fractures of the, An Attachment to the Hawley Table for the Treatment of. Ralph D. Padula 1036
[**Lumbar Vertebrae.**] The Etiology of Spondylolisthesis. Martin Batts, Jr. 879
Lunate, Kienböck's Disease of the. Edwin French Cave 858
Lung, Bone Metastasis from Primary Carcinoma of the. Report of an Unusual Case. Justin J. Stein 992
[**Luxation.**] Ankle Dislocations without Fracture. Milton J. Wilson, Arthur A. Michele, and Edwin W. Jacobson 198
[**Luxation.**] An Appliance for the Prevention of Recurrent Dislocation of the Shoulder. Josef Wolf 472
[**Luxation.**] Arthrography in Congenital Dislocation of the Hip. Erik Severin 304
[**Luxation.**] Aseptic Necrosis of Head of Femur Following Traumatic Dislocation. Frank N. Potts and Ben E. Obletz 101
[**Luxation.**] Complete Medial Dislocation of the Knee Joint with Division of the Common Peroneal Nerve. John A. Ferguson and Lyman Allen 1012
[**Luxation.**] Compound Dislocation of the Tibiotalar Joint without Fracture and without Separation. Charles Haines 205
[**Luxation.**] Dislocation of the Hamate Bone. Report of a Case. Donald C. Geist 215
[**Luxation.**] A Functioning False Shoulder Joint Following an Old Dislocation. Kenneth Christophe 916
[**Luxation.**] Habitual Dislocation of the Distal End of the Ulna. Report of a Case. Robert B. Hill 780

PAGE

[**Luxation.**] Isolated Dislocation of the Carpal Navicular. A Case Report. Joseph R. Kuth . . . 479
[**Luxation.**] Morphological Changes Accompanying Fixation of the Biceps Tendon (Nicola Operation). An Experimental Study on Animals. W. I. Norton, O. A. Mortensen, and W. E. Sullivan . . . 127
[**Luxation.**] Primary Anterior Congenital Dislocation of the Hip. H. R. McCarroll and C. H. Crego, Jr. . . . 648
Luxation, Recurrent, of the Ulnar Nerve by Congenital Posterior Position of the Medial Epicondyle of the Humerus. Michael S. Burman and Charles J. Sutro . . . 958
[**Luxation.**] Unilateral Congenital Elevation of the Ilium or Congenital Dislocation of the Sacro-Iliac Joint. A Rare Anomaly. Daniel H. Levinthal and Irving Wolin . . . 193
[**Luxation.**] The Use of Skeletal Traction as a Preliminary Procedure in the Treatment of Early Congenital Dislocation of the Hip. C. H. Crego, Jr. . . . 353

M

Malignant Giant-Cell Tumor of Bone. Report of a Case Involving the Tibia. Samuel Kleinberg . . . 433
Mandible, Congenital Absence of the Ramus of the. V. H. Kazanjian . . . 761
Mandible, Ossifying Fibroma of the, The Calcium and Phosphorus Metabolism in. Karl P. Klassen and George M. Curtis . . . 444
Marsh, Frederick Howard . . . 811
Medial Dislocation, Complete, of the Knee Joint with Division of the Common Peroneal Nerve. John A. Ferguson and Lyman Allen . . . 1012
Medial Epicondyle of the Humerus, Recurrent Luxation of the Ulnar Nerve by Congenital Posterior Position of the. Michael S. Burman and Charles J. Sutro . . . 958
Medial Sesamoid of the Great Toe, Congenital Unilateral Absence of the. Report of a Case. Paul W. Lapidus . . . 208
Metabolism, The Calcium and Phosphorus, in Ossifying Fibroma of the Mandible. Karl P. Klassen and George M. Curtis . . . 444
Metastasis to Bone from Carcinoma of the Gastro-Intestinal Tract. Ralph K. Ghormley and Jorge E. Valls . . . 74
Metastasis, Bone, from Primary Carcinoma of the Lung. Report of an Unusual Case. Justin J. Stein . . . 992
Metastasis, Skeletal, in Cancer. Charles F. Geschickter and I. H. Maseritz . . . 314
[**Metatarsal,** Second, Osteochondritis of the.] A Case of Freiberg's Disease Treated by a Walking Cast. Eugene L. Jewett . . . 778
Method for Treating Displaced Fractures of the Pelvis, A. Eugene L. Jewett . . . 177
Methods Used in Handling the Epidemic of Poliomyelitis in Ontario in 1937, The. A. B. LeMesurier . . . 867
Minnesota-Dakota Orthopedic Club . . . 805
Mississippi Valley Medical Journal . . . 490
Mississippi Valley Medical Society . . . 225
Morphological Changes Accompanying Fixation of the Biceps Tendon (Nicola Operation). An Experimental Study on Animals. W. I. Norton, O. A. Mortensen, and W. E. Sullivan . . . 127
(**Morquio's Disease**), Chondro-Osteodystrophy. Progressive Kyphosis from Congenital Wedge-Shaped Vertebrae. John F. Pohl . . . 187
Movable Traction Carrier. An Apparatus for Combining Traction with Motion at the Hip. Alvin M. Arkin . . . 1032
Muscles, Affections of. Charles F. Geschickter and I. H. Maseritz . . . 576
Muscle Tester for Poliomyelitis Cases, A. Attachment for a Permanent Record. Adolph A. Schmier . . . 475
[**Myositis.**] Affections of Muscles. Charles F. Geschickter and I. H. Maseritz . . . 576
Myositis Fibrosa, Generalized. Report of a Case. Donald C. Somers . . . 414

N

Nailing, Blind, of the T Fracture of the Lower End of the Humerus Which Involves the Joint. O. L. Miller . . . 933
Nailing, Hip, A Simplified Directional Guide for. C. Fred Ferciot . . . 1023
Navicular, Carpal, Fractures of the. Importance of Special Roentgenography. Abraham S. Rothberg . . . 1020
Navicular, Carpal, Isolated Dislocation of the. A Case Report. Joseph R. Kuth . . . 479
Navicular, Carpal, Treatment of Ununited Fractures of the. J. M. Edelstein . . . 902
Navicular, Tarsal, Osteochondritis of the Adult. James F. Brailsford . . . 111

PAGE

Necrosis, Aseptic, of Head of Femur Following Traumatic Dislocation. Frank N. Potts and Ben E. Obletz 101
Nephrolithiasis Occurring in Recumbency. R. Guy Pulvertaft 559
Nerve, Common Peroneal, Division of the, Complete Medial Dislocation of the Knee Joint with. John A. Ferguson and Lyman Allen 1012
Nerve, Ulnar, Recurrent Luxation of the, by Congenital Posterior Position of the Medial Epicondyle of the Humerus. Michael S. Burman and Charles J. Sutro 958
New Device for Facilitating the Taking of Roentgenograms When Performing the Extra-Articular Method of Internal Fixation in Fractures of the Femoral Neck, A. J. I. Sloat and Leonard T. Peterson 1041
New Electric Power Unit for Drilling and Sawing Bone, A. Wilbur J. Cox 1048
New Instrument for Passing the Parham Band, A. Harry B. Macey 1047
New Knife for the Removal of the Meniscus, A. Walter Mercer 474
New Operative Treatment of Tuberculous Coxitis in Children, A. Aladár Farkas. 323
News Notes 224, 488, 802, 1055
(**Nicola Operation**), Morphological Changes Accompanying Fixation of the Biceps Tendon. An Experimental Study on Animals. W. I. Norton, O. A. Mortensen, and W. E. Sullivan 127
[**Non-Union.**] Arthrodesis for Ununited Fracture of the Neck of the Femur. A. Bruce Gill 710
[**Non-Union.**] The Colonna Reconstruction Operation for Ununited Fractures of the Neck of the Femur. Analysis of Seventy Cases. Paul C. Colonna 701
[**Non-Union.**] The Pathology of Ununited Fractures of the Neck of the Femur with Special Reference to the Head. Dallas B. Phemister 681
Non-Union, Persistent, of the Tibia, Synostosis Operation for. A Case Report. Henry Milch 409
[**Non-Union.**] Treatment of Ununited Fractures of the Carpal Navicular. J. M. Edelstein 902
[**Non-Union.**] The Use of Hydrochloric Acid in Certain Cases of Atrophy and Delayed Calcification in Fractured Bones. Nelson W. Cornell, Alice R. Bernheim, and E. Cooper Person 40
Nucleus Pulposus, Rupture of the. An Anatomical Study. Martin Batts, Jr. 121

O

Obituaries
John Dane 799
Ernst Freund 487
Herbert Peter Howell Galloway 1052
Philip Hoffmann 800
Arthur Thornton Legg 1054
Joseph Edgar Stewart 801
Objections to the Use of Kirschner Wire for Fixation of Femoral-Neck Fractures. Seth Selig 182
Obstetrical Fractures of the Femur, Treatment of. Arnold Pavlík 939
Ontario, The Methods Used in Handling the Epidemic of Poliomyelitis in, in 1937. A. B. LeMesurier 867
Open Fixation of Intracapsular Fracture of the Femur. An Improved Technique. Otho C. Hudson and William P. Bartels 1001
Open Reduction, Fracture of the Scapula Requiring. Report of a Case. Walter R. Fischer 459
Operation for Correction of Hammer-Toe. Paul W. Lapidus 977
Operation to Improve Abduction Power of the Shoulder in Poliomyelitis, An. Alvia Brockway 451
Operative Fusion of the Hip and Subtrochanteric Osteotomy, The Recurrence of Flexion and Adduction Deformities Following. F. Harold Downing 909
Operative Reconstruction of the Paralyzed Upper Extremity. Leo Mayer 377
Orthopaedic Guild 225, 1055
Orthopaedic Treatment of Strümpell-Marie Arthritis, The. Loring T. Swaim 983
Os Calcis, Avulsion Fracture of the. Abraham S. Rothberg 218
Os Calcis, Epiphysitis of the. Harold E. Simon and Byrn Williamson 1015
Os Calcis, The Treatment of Fractures of the. Paul F. Olson 747
[**Osseous Dystrophy.**] Chondro-Osteodystrophy (Morquio's Disease). Progressive Kyphosis from Congenital Wedge-Shaped Vertebrae. John F. Pohl 187
Ossification in the Anterior Cruciate Ligament. Robert S. Garden 1027
Ossifying Fibroma of the Mandible, The Calcium and Phosphorus Metabolism in. Karl P. Klassen and George M. Curtis 444
[**Osteitis,** Chronic.] Kienböck's Disease of the Lunate. Edwin French Cave 858
Osteo-Arthritis of the Hip Joint. T. P. McMurray 1

PAGE

Osteochondritis of the Adult Tarsal Navicular. James F. Brailsford 111
Osteochondritis, Bilateral, of the Pisiform. Report of a Case. Adolph A. Schmier and Maurice P. Meyers 789
[**Osteochondritis Deformans Juvenilis.**] Coxa Plana. Report of Two Bilateral Cases in Brothers. Walter H. Hagen 1028
Osteochondritis Dissecans of the Elbow Joint. Frank G. Murphy 464
[**Osteochondritis** of the Second Metatarsal.] A Case of Freiberg's Disease Treated by a Walking Cast. Eugene L. Jewett 778
Osteochondroma of the Fibula with Resultant Foot Drop. John T. Hodgen and Frances Brennecke 405
Osteochondroma, An Unusual Location of an. Report of a Case. Martin Dobelle 781
Osteomyelitis, Acute, of a Vertebral Body Following Compression Fracture. Rodney F. Atsatt 346
Osteomyelitis, Primary Pyogenic, of the Articular Processes of the Vertebrae. Report of an Unusual Case. William H. Shehadi 969
Osteosarcoma of the Bony Pelvis Associated with Carcinoma of the Urinary Bladder. Rosemary Shoemaker and H. E. Robertson 169
Osteotomy, Subtrochanteric, The Recurrence of Flexion and Adduction Deformities Following Operative Fusion of the Hip and. F. Harold Downing 909
Osteotomy, A Two-Stage. A. B. Ferguson, F. R. Thompson, and B. B. King 715
Overgrowth of the Femoral Shaft Following Fracture in Childhood. Alexander P. Aitken, Charles W. Blackett, and John J. Cincotti 334

P

Pain, Back, Posterior Fasciotomy in the Treatment of. Clarence H. Heyman 397
Palmar and Plantar Fasciae, Dupuytren's Contracture of. Lewis Greenberg 785
Pan-Pacific Surgical Congress 489
[**Paralysis.**] Operative Reconstruction of the Paralyzed Upper Extremity. Leo Mayer 377
[**Paralysis,** Infantile.] The Methods Used in Handling the Epidemic of Poliomyelitis in Ontario in 1937. A. B. LeMesurier 867
[**Paralysis,** Infantile.] A Muscle Tester for Poliomyelitis Cases. Attachment for a Permanent Record. Adolph A. Schmier 475
[**Paralysis,** Infantile.] An Operation to Improve Abduction Power of the Shoulder in Poliomyelitis. Alvia Brockway 451
Parham Band, A New Instrument for Passing the. Harry B. Macey 1047
Patella and the Femoral Condyle, Injuries to the Cartilages of the. V. D. Chaklin 133
Pathogenesis of the Limp Due to Coxalgia. The Antalgic Gait. Jacques Calvé, Marcel Galland, and Roger de Cagny 12
Pathology of Ununited Fractures of the Neck of the Femur with Special Reference to the Head, The. Dallas B. Phemister 681
Pelvis, Bony, Osteosarcoma of the, Associated with Carcinoma of the Urinary Bladder. Rosemary Shoemaker and H. E. Robertson 169
Pelvis, Fractures of the. Management by Use of a Posterior Plaster-of-Paris Shell. G. J. Curry 384
Pelvis, A Method for Treating Displaced Fractures of the. Eugene L. Jewett 177
[**Pelvis.**] Unilateral Congenital Elevation of the Ilium or Congenital Dislocation of the Sacro-Iliac Joint. A Rare Anomaly. Daniel H. Levinthal and Irving Wolin 193
Peroneal Nerve, Common, Division of the, Complete Medial Dislocation of the Knee Joint with. John A. Ferguson and Lyman Allen 1012
Pes Valgus, Congenital Convex. L. Lamy and L. Weissman 79
Phalanx, Terminal, of the Finger, An Unusual Fracture of the. Robert A. Wise . . . 467
Philadelphia County Medical Society 225
Philip Hoffmann 800
Phosphorus Metabolism, The Calcium and, in Ossifying Fibroma of the Mandible. Karl P. Klassen and George M. Curtis 444
Pin Fixation, Longitudinal, for Certain Fractures of the Ulna and of the Femur, A Technique for. Leslie V. Rush and H. Lowry Rush 619
Pisiform, Bilateral Osteochondritis of the. Report of a Case. Adolph A. Schmier and Maurice P. Meyers 789
Pittsburgh Orthopaedic Club 489
Plantar Fasciae, Dupuytren's Contracture of Palmar and. Lewis Greenberg 785
Plaster Cast, A Simple Leg Elevator Incorporated in a. Sidney Sideman 1045
Plaster-of-Paris Shell, Management by Use of a Posterior. Fractures of the Pelvis. G. J. Curry 384

PAGE

Poliomyelitis Cases, A Muscle Tester for. Attachment for a Permanent Record. Adolph A. Schmier ... 475
Poliomyelitis, The Methods Used in Handling the Epidemic of, in Ontario in 1937. A. B. LeMesurier ... 867
Poliomyelitis, An Operation to Improve Abduction Power of the Shoulder in. Alvia Brockway ... 451
Portland Orthopaedic Club ... 225
Posterior Fasciotomy in the Treatment of Back Pain. Clarence H. Heyman ... 397
[**Posthemiplegic Chorea.**] The Diagnosis and Treatment of Athetosis and Dystonia. Tracy J. Putnam ... 948
Primary Anterior Congenital Dislocation of the Hip. H. R. McCarroll and C. H. Crego, Jr. ... 648
Primary Carcinoma of the Lung, Bone Metastasis from. Report of an Unusual Case. Justin J. Stein ... 992
Primary Pyogenic Osteomyelitis of the Articular Processes of the Vertebrae. Report of an Unusual Case. William H. Shehadi ... 969
Principles Involved in the Treatment of Congenital Club-Foot. J. H. Kite ... 595
Process, Articular, Fracture of an. Maurice H. Herzmark ... 1031
Processes, Articular, of the Vertebrae, Primary Pyogenic Osteomyelitis of the. Report of an Unusual Case. William H. Shehadi ... 969
Process, Radial Styloid, Stenosing Tendovaginitis at the. J. E. McDonald and Frank A. Stuart ... 1035
Proliferative (Especially Atrophic) Arthritis, Gold Therapy in. J. Albert Key, Herman Rosenfeld, and O. E. Tjoflat ... 339
Pseudofracture of the Tibia. Sumner M. Roberts and Edward C. Vogt ... 891
Pyogenic Osteomyelitis, Primary, of the Articular Processes of the Vertebrae. Report of an Unusual Case. William H. Shehadi ... 969

R

Radial Head and Neck, Resection of the. An End-Result Study of Thirteen Cases. Byron B. King ... 839
Radial Styloid Process, Stenosing Tendovaginitis at the. J. E. McDonald and Frank A. Stuart ... 1035
Radiologic Review ... 490
Radius, Absence of, Congenital Club-Hand Deformity Associated with: Its Surgical Correction. A Case Report. Arthur J. Davidson and M. Thomas Horwitz ... 462
[**Radius.**] Direct Leverage in the Treatment of Gunshot Fractures of the Forearm. Francisco P. Dueño ... 373
Ramus of the Mandible, Congenital Absence of the. V. H. Kazanjian ... 761
Rapid Roentgenography in the Operating Room, with a Single Solution. F. R. Wilkinson ... 387
Reconstruction Operation, The Colonna, for Ununited Fractures of the Neck of the Femur. Analysis of Seventy Cases. Paul C. Colonna ... 701
Reconstruction Operation, The Whitman. Royal Whitman ... 1051
Reconstruction, Operative, of the Paralyzed Upper Extremity. Leo Mayer ... 377
Reconstruction of Thumb after Traumatic Amputation. Donald E. Dial ... 98
Recumbency, Nephrolithiasis Occurring in. R. Guy Pulvertaft ... 559
Recurrence of Flexion and Adduction Deformities Following Operative Fusion of the Hip and Subtrochanteric Osteotomy, The. F. Harold Downing ... 909
Recurrent Dislocation of the Shoulder, An Appliance for the Prevention of. Josef Wolf ... 472
[**Recurrent Dislocation** of the Shoulder.] Morphological Changes Accompanying Fixation of the Biceps Tendon (Nicola Operation). An Experimental Study on Animals. W. I. Norton, O. A. Mortensen, and W. E. Sullivan ... 127
Recurrent Luxation of the Ulnar Nerve by Congenital Posterior Position of the Medial Epicondyle of the Humerus. Michael S. Burman and Charles J. Sutro 958
Reduction, Open, Fracture of the Scapula Requiring. Report of a Case. Walter R. Fischer ... 459
Regeneration of the Lateral Condyle of the Humerus after Excision. Allen F. Voshell and K. P. A. Taylor ... 421
[**Renal Calculi.**] Nephrolithiasis Occurring in Recumbency. R. Guy Pulvertaft ... 559
Resection of the Radial Head and Neck. An End-Result Study of Thirteen Cases. Byron B. King ... 839
Réunion d'Orthopédie et de Chirurgie de l'Appareil Moteur de Bordeaux ... 491, 807
Rheumatoid Arthritis, Gold Therapy in. David Sashin, Joseph Spanbock, and David H. Kling ... 723

PAGE

[**Roentgenography.**] A New Device for Facilitating the Taking of Roentgenograms When Performing the Extra-Articular Method of Internal Fixation in Fractures of the Femoral Neck. J. I. Sloat and Leonard T. Peterson 1041
Roentgenography, Rapid, in the Operating Room, with a Single Solution. F. R. Wilkinson 387
Roentgenography, Special, Importance of. Fractures of the Carpal Navicular. Abraham S. Rothberg 1020
Rupture of the Nucleus Pulposus. An Anatomical Study. Martin Batts, Jr. 121

S

[**Sacro-Iliac Joint.**] Posterior Fasciotomy in the Treatment of Back Pain. Clarence H. Heyman 397
Sacro-Iliac Joint, Unilateral Congenital Elevation of the Ilium or Congenital Dislocation of the. A Rare Anomaly. Daniel H. Levinthal and Irving Wolin 193
Sarcoma, Ewing's. Charles F. Geschickter and I. H. Maseritz 26
[**Sarcoma.**] Osteosarcoma of the Bony Pelvis Associated with Carcinoma of the Urinary Bladder. Rosemary Shoemaker and H. E. Robertson 169
Scapula, Fracture of the, Requiring Open Reduction. Report of a Case. Walter R. Fischer 459
[**Scapula.**] An Unusual Location of an Osteochondroma. Report of a Case. Martin Dobelle 781
Scoliosis, The Compensation-Derotation Treatment of. A. Steindler, William R. Hamsa, and William Cooper 51
Scoliosis, Experimental Production of. S. L. Haas 963
[**Semilunar Cartilage.**] A New Knife for the Removal of the Meniscus. Walter Mercer 474
Serviceable Goniometer with Supination-Pronation Attachment, A. Herbert W. Virgin, Jr. 221
Sesamoid, Medial, of the Great Toe, Congenital Unilateral Absence of the. Report of a Case. Paul W. Lapidus 208
Sheath, Tendon, The Use of Cellophane as a Permanent. Thomas Wheeldon 393
Shell, Plaster-of-Paris, Management by Use of a Posterior. Fractures of the Pelvis. G. J. Curry 384
[**Shoulder.**] Coracoclavicular Joint. Borivoye Gradoyevitch 918
Shoulder, An Operation to Improve Abduction Power of the, in Poliomyelitis. Alvia Brockway 451
[**Shoulder.**] Operative Reconstruction of the Paralyzed Upper Extremity. Leo Mayer 377
Shoulder, Recurrent Dislocation of the, An Appliance for the Prevention of. Josef Wolf 472
[**Shoulder,** Recurrent Dislocation of the.] Morphological Changes Accompanying Fixation of the Biceps Tendon (Nicola Operation). An Experimental Study on Animals. W. I. Norton, O. A. Mortensen, and W. E. Sullivan 127
Shoulder Joint, A Functioning False, Following an Old Dislocation. Kenneth Christophe 916
Simple Leg Elevator Incorporated in a Plaster Cast, A. Sidney Sideman 1045
Simplified Directional Guide for Hip Nailing, A. C. Fred Ferciot 1023
Sir Robert Jones Lecture (Hospital for Joint Diseases) 489
Skeletal Metastasis in Cancer. Charles F. Geschickter and I. H. Maseritz 314
Skeletal Traction, The Use of, as a Preliminary Procedure in the Treatment of Early Congenital Dislocation of the Hip. C. H. Crego, Jr. 353
Sleeved-Wire Method of Fixation of Fractures, A. Thomas Wheeldon 210
Società Italiana di Ortopedia e Traumatologia 491
Société Belge d'Orthopédie 225
Société Française d'Orthopédie et de Traumatologie 224
[**Spine.**] Acute Osteomyelitis of a Vertebral Body Following Compression Fracture. Rodney F. Atsatt 346
[**Spine.**] Chondro-Osteodystrophy (Morquio's Disease). Progressive Kyphosis from Congenital Wedge-Shaped Vertebrae. John F. Pohl 187
[**Spine.**] The Compensation-Derotation Treatment of Scoliosis. A. Steindler, William R. Hamsa, and William Cooper 51
[**Spine.**] The Etiology of Spondylolisthesis. Martin Batts, Jr. 879
[**Spine.**] Experimental Production of Scoliosis. S. L. Haas 963
[**Spine.**] Fracture of an Articular Process. Maurice H. Herzmark 1031
Spine of the Ilium, Avulsion of the Anterior Superior. A Case Report. Leslie V. Rush and H. Lowry Rush 206

PAGE

Spine, Lumbar, Fissure Formation in Articular Facets of the. Operative Findings in One Case. Herbert E. Hipps . . . 289
Spine, Lumbar, Thoracic, and Cervical, Fractures of the, An Attachment to the Hawley Table for the Treatment of. Ralph D. Padula . . . 1036
[**Spine.**] The Orthopaedic Treatment of Strümpell-Marie Arthritis. Loring T. Swaim . . . 983
[**Spine.**] Primary Pyogenic Osteomyelitis of the Articular Processes of the Vertebrae. Report of an Unusual Case. William H. Shehadi . . . 969
[**Spine.**] Rupture of the Nucleus Pulposus. An Anatomical Study. Martin Batts, Jr. . . . 121
[**Spine.**] Vertebral Lesions in Undulant Fever. W. A. Bishop, Jr. . . . 665
Spondylolisthesis, The Etiology of. Martin Batts, Jr. . . . 879
Stenosing Tendovaginitis at the Radial Styloid Process. J. E. McDonald and Frank A. Stuart . . . 1035
Stewart, Joseph Edgar . . . 801
Straps, Elastic, to Prevent Slipping of a Knee Cage. Raphael R. Goldenberg . . . 797
Strümpell-Marie Arthritis, The Orthopaedic Treatment of. Loring T. Swaim . . . 983
Styloid Process, Radial, Stenosing Tendovaginitis at the. J. E. McDonald and Frank A. Stuart . . . 1035
Subtrochanteric Osteotomy, The Recurrence of Flexion and Adduction Deformities Following Operative Fusion of the Hip and. F. Harold Downing . . . 909
Supination-Pronation Attachment, A Serviceable Goniometer with. Herbert W. Virgin, Jr. . . . 221
Supracondylar Fracture of the Femur with Anterior Position of the Lower Fragment. Drury Hinton . . . 719
Surgical Treatment of Joint Tuberculosis. Mather Cleveland . . . 607
Synostosis Operation for Persistent Non-Union of the Tibia. A Case Report. Henry Milch . . . 409

T

Table, Hawley, Arm Control for Operations on the Upper Extremity on the. George W. Hawley . . . 794
Table, Hawley, An Attachment to the, for the Treatment of Fractures of the Lumbar, Thoracic, and Cervical Spine. Ralph D. Padula . . . 1036
Talipes Equinus, Congenital Bilateral, in Twins. Paul W. Lapidus . . . 792
Tarsal Navicular, Osteochondritis of the Adult. James F. Brailsford . . . 111
Technique for Longitudinal Pin Fixation of Certain Fractures of the Ulna and of the Femur, A. Leslie V. Rush and H. Lowry Rush . . . 619
Temperature-Controlled Healing of Experimental Fractures. Kellogg Speed and Egbert H. Fell . . . 1005
Tendon of Attachment of Biceps Brachii, Avulsion of. A Case Report. S. Perry Rogers . . . 197
Tendon, Biceps, Fixation of the, (Nicola Operation), Morphological Changes Accompanying. An Experimental Study on Animals. W. I. Norton, O. A. Mortensen, and W. E. Sullivan . . . 127
Tendon Sheath, Permanent, The Use of Cellophane as a. Thomas Wheeldon . . . 393
Tendon Transplantation. An End-Result Study of 458 Transplantations. Alvin R. Carpenter . . . 921
Tendovaginitis, Stenosing, at the Radial Styloid Process. J. E. McDonald and Frank A. Stuart . . . 1035
Terminal Phalanx of the Finger, An Unusual Fracture of the. Robert A. Wise . . . 467
Tester, A Muscle, for Poliomyelitis Cases. Attachment for a Permanent Record. Adolph A. Schmier . . . 475
T Fracture of the Lower End of the Humerus Which Involves the Joint, Blind Nailing of the. O. L. Miller . . . 933
Thoracic, and Cervical Spine, Fractures of the Lumbar, An Attachment to the Hawley Table for the Treatment of. Ralph D. Padula . . . 1036
Thumb, Reconstruction of, after Traumatic Amputation. Donald E. Dial . . . 98
Tibia, Adamantinoma of the. John O. Rankin . . . 425
Tibia, Pseudofracture of the. Sumner M. Roberts and Edward C. Vogt . . . 891
Tibia, Report of a Case Involving the. Malignant Giant-Cell Tumor of Bone. Samuel Kleinberg . . . 433
Tibia, Synostosis Operation for Persistent Non-Union of the. A Case Report. Henry Milch . . . 409
Tibial Condyle, Lateral, Compression Fractures of the, and Their Treatment. Ivar Palmer . . . 674
Tibiotalar Joint, Compound Dislocation of the, without Fracture and without Separation. Charles Haines . . . 205

PAGE

[**Toe.**] A Case of Freiberg's Disease Treated by a Walking Cast. Eugene L. Jewett . . . 778
Toe, Great, Congenital Unilateral Absence of the Medial Sesamoid of the. Report of a Case. Paul W. Lapidus . . . 208
Toe, Hammer-, Operation for Correction of. Paul W. Lapidus . . . 977
Traction, Skeletal, The Use of, as a Preliminary Procedure in the Treatment of Early Congenital Dislocation of the Hip. C. H. Crego, Jr. . . . 353
Traction Carrier, Movable. An Apparatus for Combining Traction with Motion at the Hip. Alvin M. Arkin . . . 1032
Transcondylar Fractures of the Humerus in Childhood. John Dunlop . . . 59
[**Transplantation,** Tendon.] An End-Result Study of 458 Transplantations. Alvin R. Carpenter . . . 921
[**Transplantation of Trapezius.**] Operative Reconstruction of the Paralyzed Upper Extremity. Leo Mayer . . . 377
Traumatic Amputation, Reconstruction of Thumb after. Donald E. Dial . . . 98
Traumatic Dislocation, Aseptic Necrosis of Head of Femur Following. Frank N. Potts and Ben E. Obletz . . . 101
Treatment of Fractures of the Neck of the Femur by Internal Fixation. Report of the Fracture Committee of the American Academy of Orthopaedic Surgeons. M. N. Smith-Petersen and H. Earle Conwell . . . 483
Treatment of Fractures of the Os Calcis, The. Paul F. Olson . . . 747
Treatment of Intertrochanteric Fractures, The. William P. Bartels . . . 773
Treatment of Obstetrical Fractures of the Femur. Arnold Pavlík . . . 939
Treatment of Ununited Fractures of the Carpal Navicular. J. M. Edelstein . . . 902
Trochanter, Lesser, Isolated Fracture of the. Milton J. Wilson, Arthur A. Michele, and Edwin W. Jacobson . . . 776
Tuberculosis, Bone and Joint, The Use of Insulin as an Adjunct in the Treatment of. Russell L. Nichols and Edward L. Compere . . . 885
Tuberculosis, Joint, Surgical Treatment of. Mather Cleveland . . . 607
Tuberculosis of the Long Bones. A Report of Six Cases. Frank C. Hodges . . . 148
Tuberculous Coxitis in Children, A New Operative Treatment of. Aladár Farkas . . . 323
[**Tumor.**] Adamantinoma of the Tibia. John O. Rankin . . . 425
[**Tumor.**] Affections of Muscles. Charles F. Geschickter and I. H. Maseritz . . . 576
[**Tumor.**] Bone Metastasis from Primary Carcinoma of the Lung. Report of an Unusual Case. Justin J. Stein . . . 992
[**Tumor.**] The Calcium and Phosphorus Metabolism in Ossifying Fibroma of the Mandible. Karl P. Klassen and George M. Curtis . . . 444
[**Tumor.**] Ewing's Sarcoma. Charles F. Geschickter and I. H. Maseritz . . . 26
Tumor, Malignant Giant-Cell, of Bone. Report of a Case Involving the Tibia. Samuel Kleinberg . . . 433
[**Tumor.**] Metastasis to Bone from Carcinoma of the Gastro-Intestinal Tract. Ralph K. Ghormley and Jorge E. Valls . . . 74
[**Tumor.**] Osteochondroma of the Fibula with Resultant Foot Drop. John T. Hodgen and Frances Brennecke . . . 405
[**Tumor.**] Osteosarcoma of the Bony Pelvis Associated with Carcinoma of the Urinary Bladder. Rosemary Shoemaker and H. E. Robertson . . . 169
[**Tumor.**] Skeletal Metastasis in Cancer. Charles F. Geschickter and I. H. Maseritz . . . 314
[**Tumor.**] An Unusual Location of an Osteochondroma. Report of a Case. Martin Dobelle . . . 781
Tumors, Xanthomatous, of Joints. Dominic A. De Santo and Philip D. Wilson . . . 531
Twins, Congenital Bilateral Talipes Equinus in. Paul W. Lapidus . . . 792
Two-Stage Osteotomy, A. A. B. Ferguson, F. R. Thompson, and B. B. King . . . 715

U

Ulna, Certain Fractures of the, and of the Femur, A Technique for Longitudinal Pin Fixation of. Leslie V. Rush and H. Lowry Rush . . . 619
Ulna, Habitual Dislocation of the Distal End of the. Report of a Case. Robert B. Hill . . . 780
Ulnar Nerve, Recurrent Luxation of the, by Congenital Posterior Position of the Medial Epicondyle of the Humerus. Michael S. Burman and Charles J. Sutro . . . 958
Umberto I Prize . . . 489
Undulant Fever, Vertebral Lesions in. W. A. Bishop, Jr. . . . 665
Unilateral Congenital Elevation of the Ilium or Congenital Dislocation of the Sacro-Iliac Joint. A Rare Anomaly. Daniel H. Levinthal and Irving Wolin . . . 193
Ununited Fractures of the Carpal Navicular, Treatment of. J. M. Edelstein . . . 902
Ununited Fracture of the Neck of the Femur, Arthrodesis for. A. Bruce Gill . . . 710

PAGE

Ununited Fractures of the Neck of the Femur, The Colonna Reconstruction Operation for. Analysis of Seventy Cases. Paul C. Colonna ... 701
Ununited Fractures of the Neck of the Femur, The Pathology of, with Special Reference to the Head. Dallas B. Phemister ... 681
[**Ununited Fractures.**] Synostosis Operation for Persistent Non-Union of the Tibia. A Case Report. Henry Milch ... 409
[**Ununited Fractures.**] The Use of Hydrochloric Acid in Certain Cases of Atrophy and Delayed Calcification in Fractured Bones. Nelson W. Cornell, Alice R. Bernheim, and E. Cooper Person ... 40
Unusual Fracture of the Terminal Phalanx of the Finger, An. Robert A. Wise ... 467
Unusual Location of an Osteochondroma, An. Report of a Case. Martin Dobelle 781
Urinary Bladder, Osteosarcoma of the Bony Pelvis Associated with Carcinoma of the. Rosemary Shoemaker and H. E. Robertson ... 169
Use of Cellophane as a Permanent Tendon Sheath, The. Thomas Wheeldon ... 393
Use of Hydrochloric Acid in Certain Cases of Atrophy and Delayed Calcification in Fractured Bones, The. Nelson W. Cornell, Alice R. Bernheim, and E. Cooper Person ... 40
Use of Insulin as an Adjunct in the Treatment of Bone and Joint Tuberculosis, The. Russell L. Nichols and Edward L. Compere ... 885
Use of Skeletal Traction as a Preliminary Procedure in the Treatment of Early Congenital Dislocation of the Hip, The. C. H. Crego, Jr. ... 353
Utilization of the Body Weight in Treatment of the Residual Deformity in Club Feet. R. Saunders Melville ... 456

V

Vertebrae, Congenital Wedge-Shaped, Progressive Kyphosis from. Chondro-Osteodystrophy (Morquio's Disease). John F. Pohl ... 187
[**Vertebrae.**] Experimental Production of Scoliosis. S. L. Haas ... 963
[**Vertebrae.**] Fracture of an Articular Process. Maurice H. Herzmark ... 1031
[**Vertebrae, Lumbar.**] The Etiology of Spondylolisthesis. Martin Batts, Jr. ... 879
Vertebrae, Primary Pyogenic Osteomyelitis of the Articular Processes of the. Report of an Unusual Case. William H. Shehadi ... 969
Vertebral Body, Acute Osteomyelitis of a, Following Compression Fracture. Rodney F. Atsatt ... 346
Vertebral Lesions in Undulant Fever. W. A. Bishop, Jr. ... 665
Volkmann's Contracture as a Complication of Fractures of the Forearm and Elbow. J. Neill Garber ... 154

W

Walking Cast, A Case of Freiberg's Disease Treated by a. Eugene L. Jewett ... 778
Walter M. Brickner Lecture (Hospital for Joint Diseases) ... 224
Wedge-Shaped Vertebrae, Congenital, Progressive Kyphosis from. Chondro-Osteodystrophy (Morquio's Disease). John F. Pohl ... 187
Weight, Utilization of the Body, in Treatment of the Residual Deformity in Club Feet. R. Saunders Melville ... 456
Whitman Reconstruction Operation, The. Royal Whitman ... 1051
Wire, Kirschner, Objections to the Use of, for Fixation of Femoral-Neck Fractures. Seth Selig ... 182
Wire Method, A Sleeved-, of Fixation of Fractures. Thomas Wheeldon ... 210
World Conference of Workers for Cripples ... 491, 1057
[**Wrist.**] Bilateral Osteochondritis of the Pisiform. Report of a Case. Adolph A. Schmier and Maurice P. Meyers ... 789
[**Wrist.**] Dislocation of the Hamate Bone. Report of a Case. Donald C. Geist ... 215
[**Wrist.**] Fractures of the Carpal Navicular. Importance of Special Roentgenography. Abraham S. Rothberg ... 1020
[**Wrist.**] Habitual Dislocation of the Distal End of the Ulna. Report of a Case. Robert B. Hill ... 780
[**Wrist.**] Isolated Dislocation of the Carpal Navicular. A Case Report. Joseph R. Kuth ... 479
[**Wrist.**] Kienböck's Disease of the Lunate. Edwin French Cave ... 858
[**Wrist.**] Treatment of Ununited Fractures of the Carpal Navicular. J. M. Edelstein ... 902

X

Xanthomatous Tumors of Joints. Dominic A. De Santo and Philip D. Wilson ... 531

TABLE OF CONTENTS

(*Continued*)

PAGE

Open Fixation of Intracapsular Fracture of the Femur. An Improved Technique.
By *Otho C. Hudson, M.D.*, and *William P. Bartels, M.D.*, Hempstead, New York 1001

Temperature-Controlled Healing of Experimental Fractures.
By *Kellogg Speed, M.D.*, and *Egbert H. Fell, M.D.*, Chicago, Illinois 1005

Complete Medial Dislocation of the Knee Joint with Division of the Common Peroneal Nerve.
By *John A. Ferguson, M.D.*, and *Lyman Allen, M.D.*, Burlington, Vermont 1012

Epiphysitis of the Os Calcis.
By *Harold E. Simon, M.D.*, and *Byrn Williamson, M.D.*, Birmingham, Alabama 1015

Fractures of the Carpal Navicular. Importance of Special Roentgenography.
By *Abraham S. Rothberg, M.D.*, New York, N. Y. 1020

A Simplified Directional Guide for Hip Nailing.
By *C. Fred Ferciot, M.D.*, Lincoln, Nebraska 1023

Ossification in the Anterior Cruciate Ligament.
By *Robert S. Garden, F.R.C.S.E.*, Liverpool, England 1027

Coxa Plana. Report of Two Bilateral Cases in Brothers.
By *Walter H. Hagen, M.D.*, East Orange, New Jersey 1028

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Index to Volume XXI 1087

Addresses of Contributors ..... Cover 3

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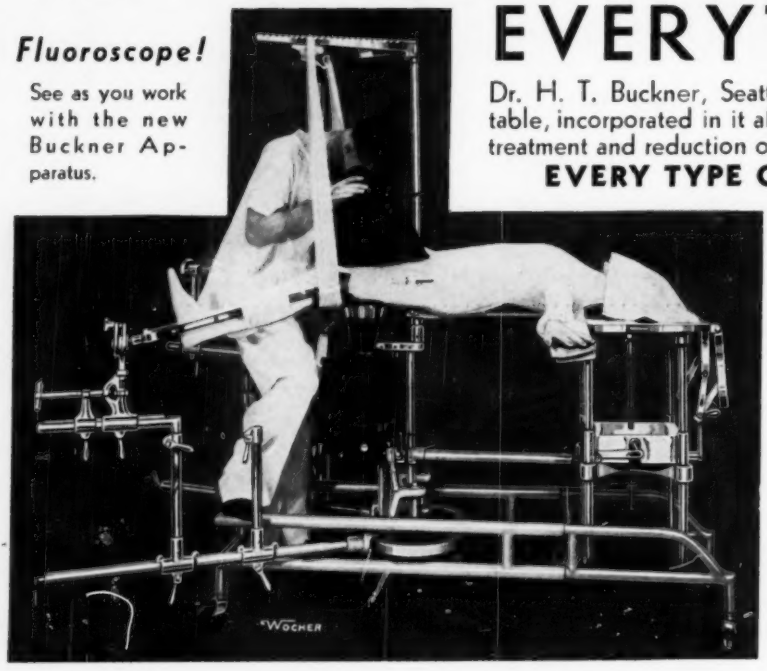

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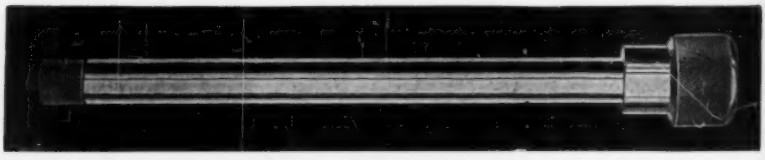

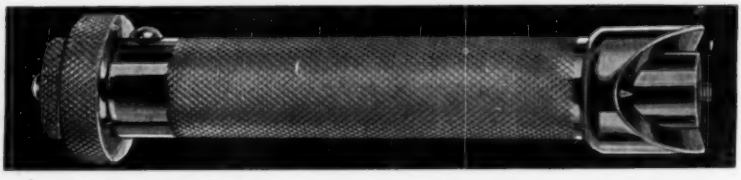

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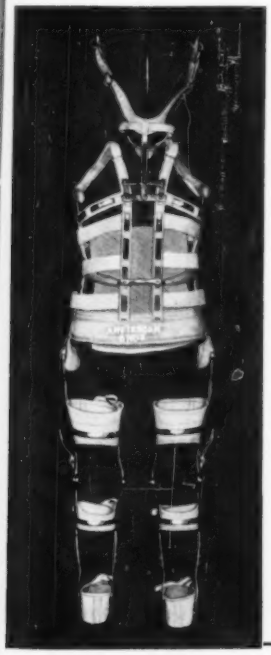

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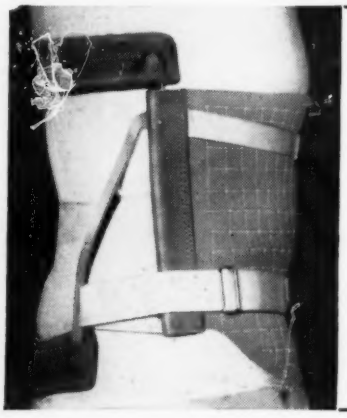

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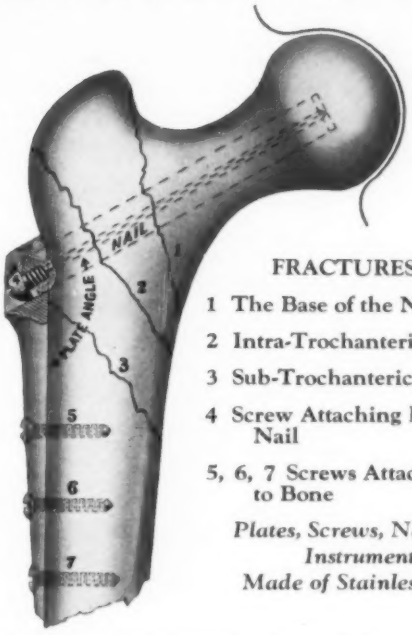

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Amsterdam Bros. Inc.	23
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Bard-Parker Company, Inc.	2
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Otto K. Becker Company	21
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The British Journal of Surgery	27
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